GROUP 11B

ENGINE OVERHAUL <4A9>

CONTENTS

Main Index
Group TOC

GENERAL INFORMATION

M1113000100976

Vehicle name	Vehicle model	Engine model	Displacement mL	Specification
Colt	Z23A	4A91	1,499	Double overhead camshaft, 16-valve

GENERAL SPECIFICATIONS

M1113000200962

Item		4A91
Total displacement mL		1,499
Bore × stroke mm		75.0 × 84.8
Compression ratio		10.0
Combustion chamber		Pentroof type
Camshaft arrangement		DOHC
Number of valve	Intake	2
	Exhaust	2
Valve timing	Intake opening	BTDC 31° – ATDC 19°
	Intake closing	ABDC 21° – ABDC 71°
	Exhaust opening	BBDC 39°
	Exhaust closing	ATDC 5°
Fuel system		Electronically controlled multipoint fuel injection
Rocker arm		None
Auto-lash adjuster		None

SERVICE SPECIFICATIONS

M1113000301014

Item		Standard value	Limit
TIMING CHAIN			
Valve clearance mm	Intake	0.22	–
	Exhaust	0.30	–
CAMSHAFT			
Cam height mm	Intake	44.71	44.21
	Exhaust	44.28	43.78
CYLINDER HEAD AND VALVES			
Cylinder head bottom face distortion mm		0.03 or less	0.2
Cylinder head bottom surface grinding limit (Total resurfacing depth of both cylinder head and cylinder block) mm		–	0.2
Cylinder head overall height mm		112.9 – 113.1	–

Item		Standard value	Limit
Valve margin mm	Intake	1.35	0.85
	Exhaust	1.85	1.35
Valve stem outside diameter mm	Intake	4.965 – 4.980	–
	Exhaust	4.955 – 4.970	–
Valve face angle		45°– 45.5°	–
Valve stem-to-guide clearance mm	Intake	0.020 – 0.047	0.10
	Exhaust	0.030 – 0.057	0.15
Valve length mm	Intake	89.61	89.11
	Exhaust	90.94	90.44
Valve stem protrusion mm	Intake	38.46	38.96
	Exhaust	38.49	38.99
Valve spring free length mm		43.1	42.1
Valve spring load / installed height N/mm		152/33.4	–
Valve spring out-of-squareness		2° or less	4°
Valve seat contact width mm		1.1 – 1.5	–
Valve guide inside diameter mm		5.000 – 5.012	–
Valve guide installed height mm		7.9 – 8.3	–
PISTON AND CONNECTING ROD			
Piston outer diameter mm		75	–
Piston ring to ring groove clearance mm	No. 1	0.03 – 0.07	0.1
	No. 2	0.02 – 0.06	0.1
Piston ring end gap mm	No. 1	0.15 – 0.30	0.8
	No. 2	0.20 – 0.40	0.8
	Oil ring	0.10 – 0.40	1.0
Piston pin outer diameter mm		18	–
Piston pin press-fitting load (at room temperature) N		5,000 – 11,000	–
Crankshaft pin oil clearance mm		0.014 – 0.059	0.1
Connecting rod big end thrust clearance mm		0.10 – 0.35	0.4
CRANKSHAFT AND CYLINDER BLOCK			
Crankshaft end play mm		0.09 – 0.27	0.3
Crankshaft journal outer diameter mm		46	–
Crankshaft pin outer diameter mm		40	–
Crankshaft journal oil clearance mm		0.014 – 0.034	0.1
Cylinder block top surface distortion mm		0.05	0.1
Cylinder block top face grinding limit (Total resurfacing depth of both cylinder head and cylinder block) mm		–	0.2
Cylinder block overall height mm		280	–

Main Index
Group TOC

Item	Standard value	Limit
Cylinder bore mm	75	–
Cylindrically mm	0.007 or less	–
Piston to cylinder clearance mm	0.010 – 0.035	–

TORQUE SPECIFICATIONS

M1113023401788

Items		N·m
ALTERNATOR AND IGNITION SYSTEM		
Spark plugs		25 ± 5
Ignition coil bolt		8.4 ± 0.6
Tensioner pulley bolts		49 ± 9
Crankshaft pulley bolts		190
Water pump pulley bolts		8.4 ± 0.65
Adjust bolt		5.0 ± 1.0
Alternator brace bolt (M6)	Hexagon bolts	11 ± 1
	Torx bolts	8.4 ± 0.6
Alternator brace bolt (M10)		36.0 ± 3.6
Alternator nut (M8)		22.5 ± 2.5
Alternator nut (M10)		47 ± 5
Oil level gauge guide bolt		7.6 ± 0.6
FUEL AND EMISSION PARTS		
Delivery pipe and injector assembly bolts		18.4 ± 1.4
Manifold absolute pressure (MAP) sensor bolts		6.0 ± 0.5
Throttle body bolts		6.0 ± 0.5
Solenoid valve nut		7.6 ± 0.6
Engine hanger bolts		18.4 ± 1.4
INLET MANIFOLD		
Water inlet pipe bolt		7.6 ± 0.6
Water inlet fitting bolts		8.4 ± 0.65
Engine coolant temperature sensor		29.4 ± 9.8
Crank angle sensor bolts		8.4 ± 0.6
Camshaft position bolt		8.4 ± 0.6
Detonation sensor bolt		20 ± 1
Oil pressure switch bolts		10 ± 2
Inlet manifold bolts		13.4 ± 6.4
EGR pipe nuts		18 ± 1
EGR pipe bolts		7.6 ± 0.6
Special bolts		13.4 ± 6.4

Items	N·m
Inlet manifold stay bolts	13.4 ± 6.4
Inlet manifold stay nuts	13.4 ± 6.4
EXHAUST MANIFOLD	
Exhaust manifold bracket A bolts	20 ± 1.6
Exhaust manifold bracket B bolts	34.5 ± 6.5
Exhaust manifold nuts	35 ± 2
Heat protector bolts	6.0 ± 1.0
OIL PAN AND TIMING CHAIN CASE	
Timing chain case bolts (M10)	39.5 ± 3.0
Timing chain case bolts (M6)	8.4 ± 0.6
Water pump bolts	8.4 ± 0.6
Cover bolts	8.4 ± 0.6
Oil screen bolts	11.5 ± 1.1
Oil pan bolts	9.5 ± 0.5
Cylinder head cover bolts	9.0 ± 1.0
Oil filter bracket bolts	20 ± 1
Drain plug	39 ± 5
TIMING CHAIN	
V.V.T. sprocket bolt	64.9 ± 5.9
Camshaft sprocket bolts	88 ± 10
Tensioner lever assembly bolt	23.5 ± 4.5
Chain guide assembly bolt	10 ± 2
Timing chain tensioner assembly bolt	8.4 ± 0.6
CAMSHAFT	
Oil feeder control valve (OCV) bolts	7.6 ± 0.6
Oil feeder control valve (OCV) filter bolts	44 ± 5
Camshaft bearing cap bolts (M6)	11 ± 1
Camshaft bearing cap bolts (M8)	20 ± 1
CYLINDER HEAD AND VALVES	
Cylinder head bolts	24.5 ± 2.0 → +180° to 184°
PISTON AND CONNECTING ROD	
Connecting rod cap bolts	15 ± 2 → +90° to 94°
CRANKSHAFT AND CYLINDER BLOCK	
Crankshaft sensing ring screw	9.0 ± 1.0
Bearing cap bolts	35 ± 2 → +60° to 64°
Oil seal case bolts	7.6 ± 0.6
Bell housing cover bolts	6.7 ± 1.3
Drive plate bolts	100 ± 5
Flywheel bolts	100 ± 5

Main Index
Group TOC

SEALANTS

M1113000500888

Application points	Specified sealant
Cylinder block rear oil seal mounting face	LOCTITE 5971 or exact equivalent
Balancer shaft side cover	LOCTITE 5971 or exact equivalent
Oil pan	LOCTITE 5971 or exact equivalent
Cylinder head cover	LOCTITE 5971 or exact equivalent
Timing chain case	LOCTITE 5971 or exact equivalent
Cylinder block crank angle sensor mounting face	LOCTITE 5971 or exact equivalent
Drine plate bolt	LOCTITE 2701 or equivalent
Oil pressure switch	LOCTITE 565 or equivalent
Engine coolant temperature sensor	LOCTITE 262 or equivalent

FORM-IN-PLACE GASKET (FIPG)

The engine has several areas where the form-in-place gasket (FIPG) is in use. To ensure that the gasket fully serves its purpose, it is necessary to observe some precautions when applying the gasket.

Bead size, continuity and location are of paramount importance. Too thin a bead could cause leaks. Too thick a bead, on the other had, could be squeezed out of location, causing blocking or narrowing of the fluid feed line. To eliminate the possibility of leaks from a joint, therefore, it is absolutely necessary to apply the gasket evenly without a break, while observing the correct bead size.

Since the FIPG used in the engine is hardens as it reacts with the moisture in the atmospheric air, it is normally used in the metallic flange areas.

Disassembly

The parts assembled with the FIPG can be easily disassembled without use of a special method. In some cases, however, the sealant between the joined surfaces may have to be broken by lightly striking a part with a mallet or similar tool. A flat and thin gasket scraper may be lightly hammered in between the joined surfaces. In this case, however, care must be taken to prevent damage to the joined surfaces.

Surface Preparation

Thoroughly remove all substances deposited on the gasket application surfaces, using a gasket scraper or wire brush. Check to ensure that the surfaces to which the FIPG is to be applied is flat. Make sure that there are no oils, greases and foreign substances deposited on the application surfaces. Do not forget to remove the old gasket remaining in the bolt holes.

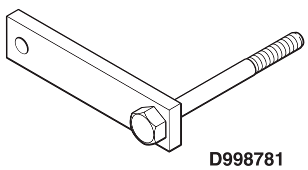
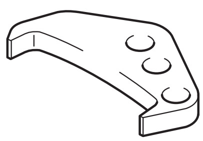
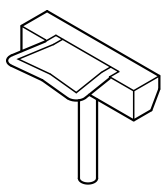
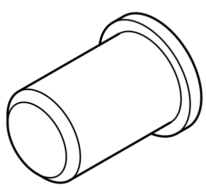
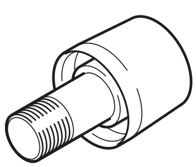
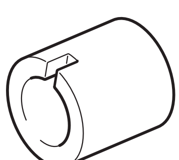
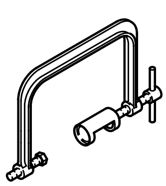
Application

Apply FIPG as a bead of the specified size without breaks. Be sure to encircle the bolt hole circumference with a completely continuous bead. The FIPG can be wiped away unless it is hardened. While the FIPG is still moist (in less than 3 minutes), mount the parts in position. When the parts are mounted, make sure that the gasket is applied to the required area only. Never apply oil or water on the FIPG nor start the engine until a sufficient time (approx. 2 hours) has passed. The FIPG application procedure may vary on different areas. Observe the procedure described in the text when applying the FIPG.

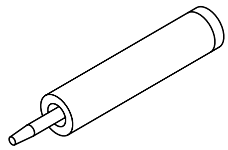
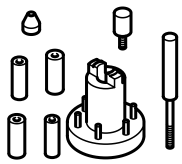
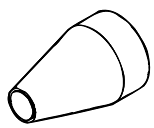
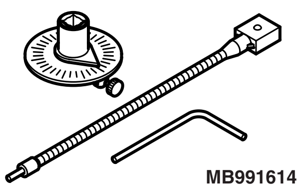
Main Index
Group TOC

SPECIAL TOOLS

M1113000601628

Tool	Number	Name	Use
 D998781	MD998781	Flywheel stopper	Retention of flywheel
 MB991883	MB991883	Flywheel stopper	Retention of flywheel
 D998727	MD998727	Oil pan remover	Removal of oil pan
	MB990699	Differential oil seal installer	Installation of front oil seal
 B991993	MB991993	Crankshaft front oil seal guide	Installation of chain case
 B992000	MB992000	Crankshaft adapter	Turn the crankshaft
 D999597	MD999597	Valve spring compressor	Compression of valve spring

Main Index
Group TOC

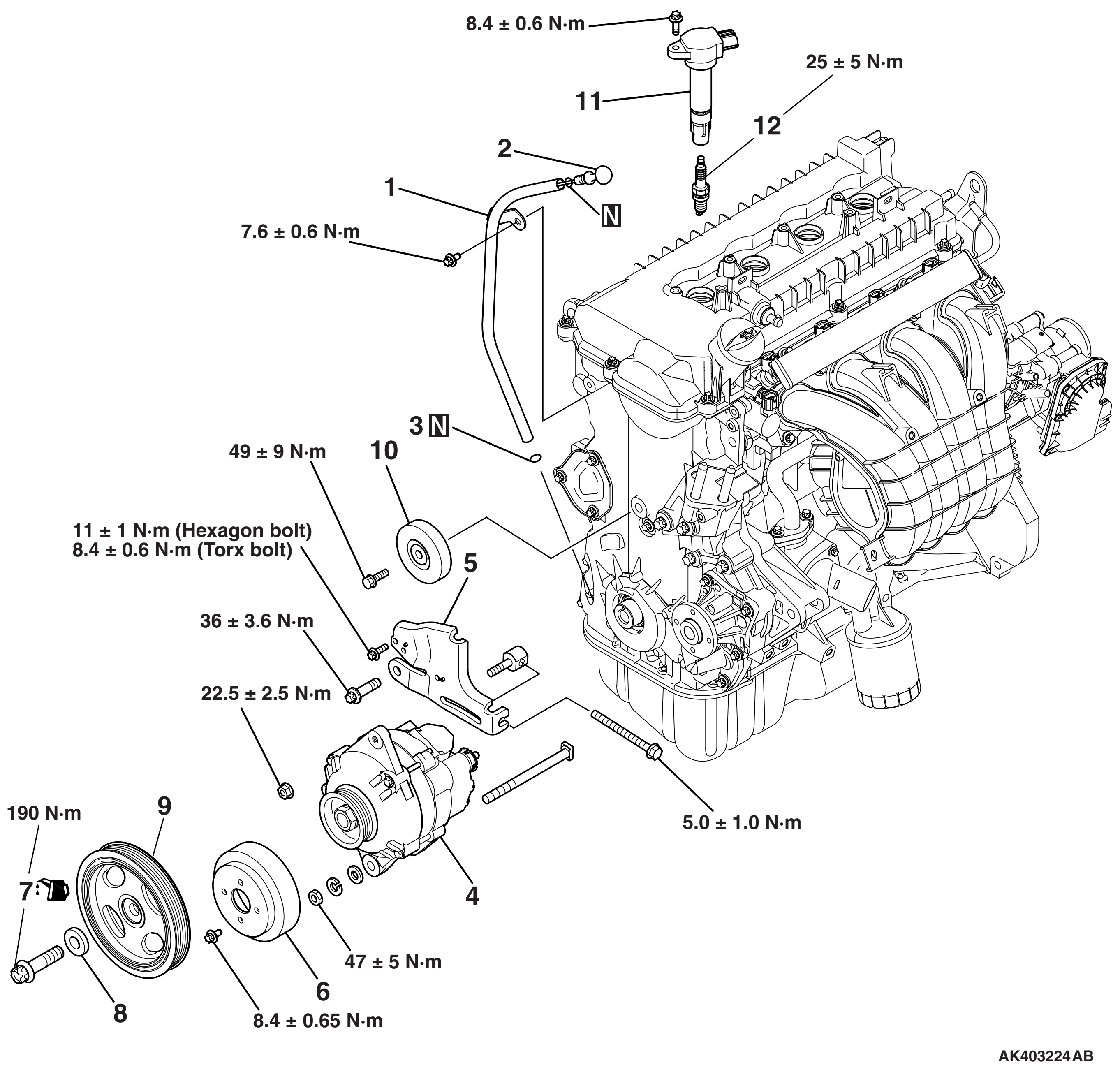
Tool	Number	Name	Use
	MB991994	Valve stem seal installer	Installation of valve stem seal (Use the special tool, on which the number "MB991994" is stamped.)
	MD998780	Piston pin setting tool	Removal and press-fitting of piston pin
	MB991659	Guide D	
	MB991614	Angle gauge	Tightening cylinder block bearing cap bolt

Main Index
Group TOC

ALTERNATOR AND IGNITION SYSTEM

REMOVAL AND INSTALLATION

M1113001001306



Removal steps

1. Oil level gauge guide
2. Oil level gauge
3. O-ring
4. Alternator
5. Alternator brace
6. Water pump pulley

<<**A**>> >>**A**<< 7. Crankshaft pulley bolt

Removal steps (Continued)

>>**A**<< 8. Washer

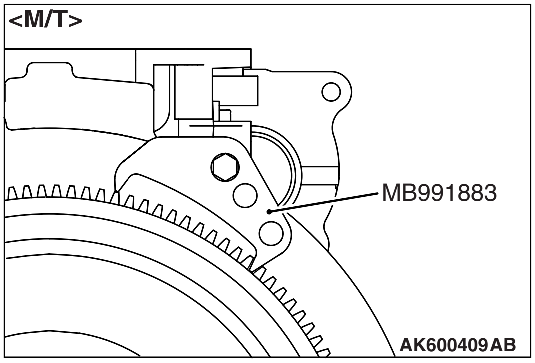
>>**A**<< 9. Crankshaft pulley

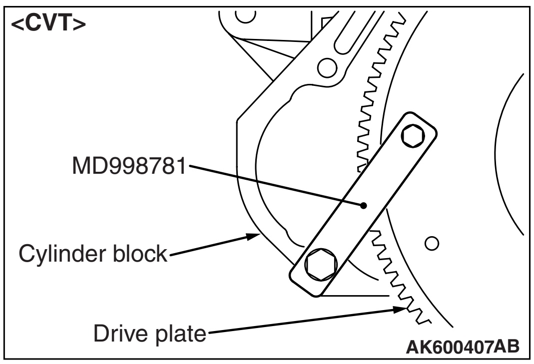
10. Tensioner pulley
11. Ignition coil
12. Spark plug

Main Index
Group TOC

REMOVAL SERVICE POINTS

<<A>> CRANKSHAFT PULLEY BOLT REMOVAL

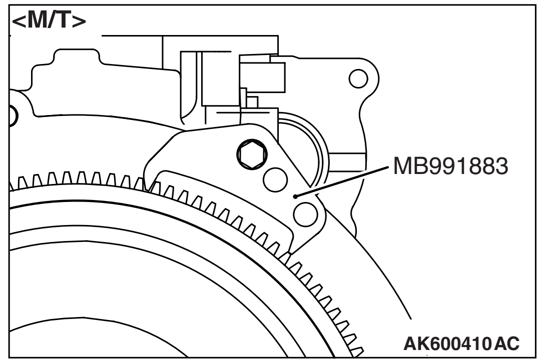


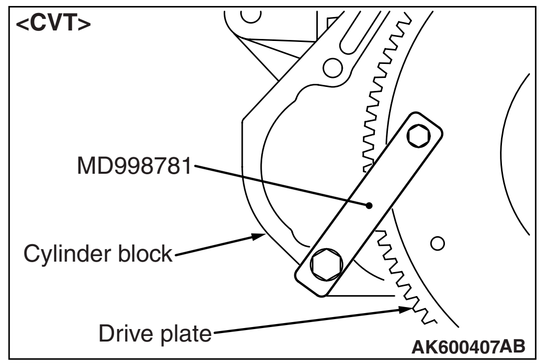


1. Lock the drive plate or the flywheel with the special tool Flywheel Stopper.
2. Remove the crankshaft bolt.
   - Flywheel Stopper (MD998781)
   - Flywheel Stopper (MB991883)

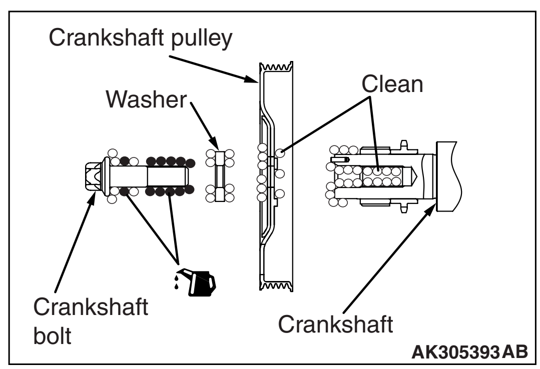
INSTALLATION SERVICE POINTS

>>A<< CRANKSHAFT PULLEY / WASHER / CRANKSHAFT PULLEY BOLT INSTALLATION





1. Lock the drive plate or the flywheel with the special tool Flywheel Stopper.
   - Flywheel Stopper (MD998781)
   - Flywheel Stopper (MB991883)



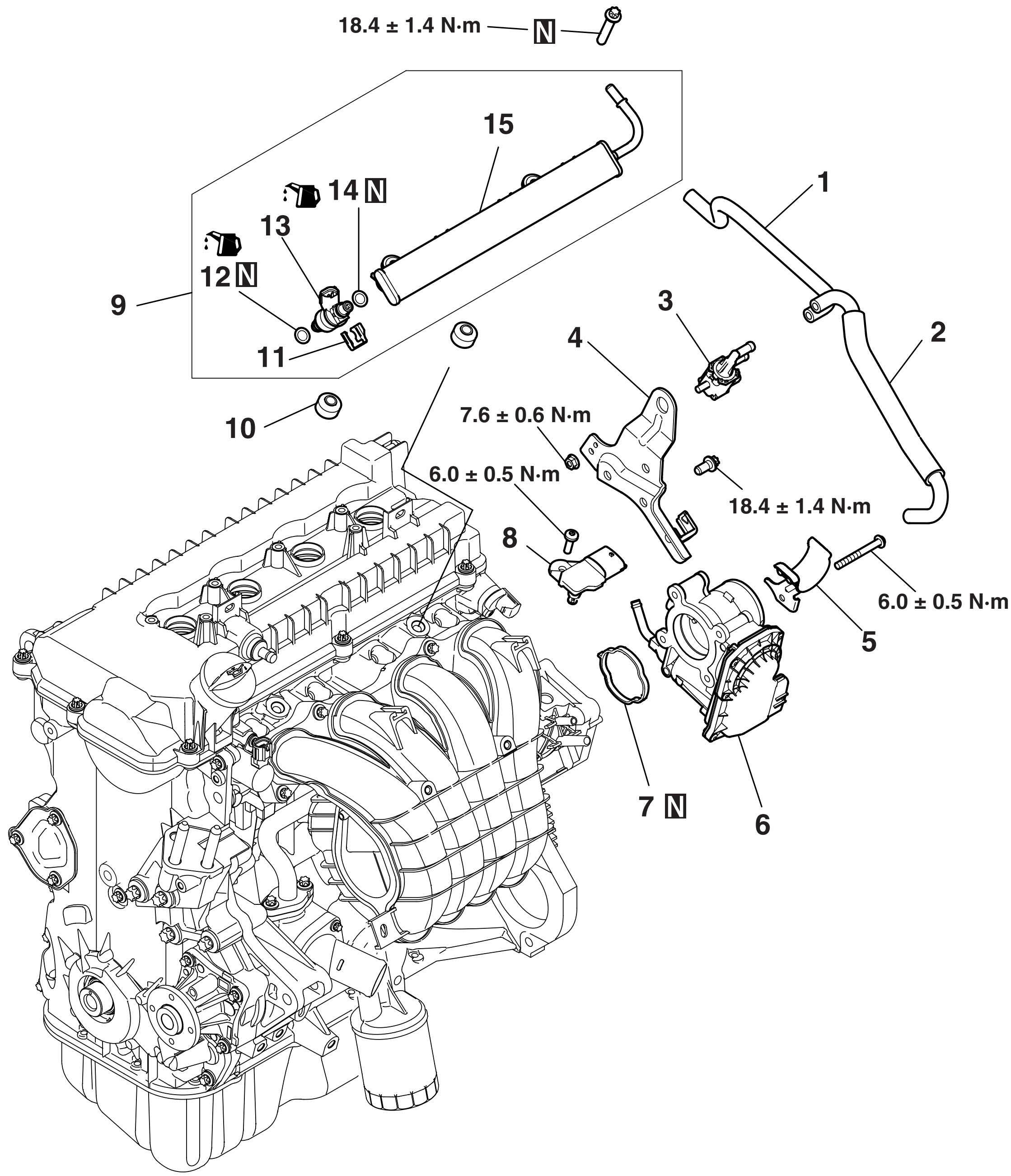
2. Clean the threaded holes in the crankshaft.
3. Clean and degrease the crankshaft pulley.

   NOTE: Degreasing is required to prevent any remaining oil from compromising the friction coefficient of the pulley belt contact surface.
4. Install the crankshaft pulley.
5. Apply an appropriate minimum amount of engine oil to the threaded portion as well as the flange bottom of the crankshaft.
6. Clean the washer.
7. Tighten the crankshaft bolt to 190 N·m.

FUEL AND EMISSION PARTS

REMOVAL AND INSTALLATION

M1113002200894



Removal steps

1. Vacuum hose
2. Vacuum hose
3. Solenoid valve
4. Engine hanger
5. Radiator upper hose clamp

>>**D**<< 6. Throttle body
>>**C**<< 7. Throttle body gasket
>>**B**<< 8. Manifold absolute pressure (MAP) sensor
>>**A**<< 9. Delivery pipe assembly

Removal steps (Continued)

10. Insulator
11. Injection support
12. O-ring
13. Fuel injector
14. O-ring
15. Delivery pipe

Main Index
Group TOC

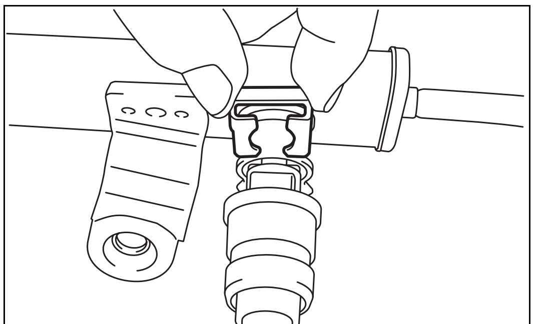
INSTALLATION SERVICE POINTS

>>A<< DELIVERY PIPE ASSEMBLY INSTALLATION

⚠ CAUTION

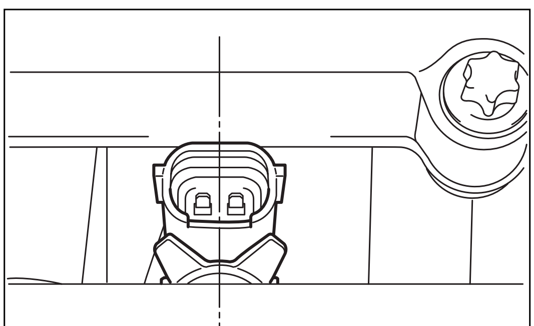
Be sure not to allow engine oil entering into the delivery pipe.

1. Lightly coat the injector's O-rings with new engine oil. Insert the injector squarely into the delivery pipe. Do not insert it aslant.
2. Ensure that the injector can rotate smoothly. If not, remove the injector, check the O-ring for damage, replace the O-ring as required, then try to install the injector again.



AK304914

3. Install the injector support.



AK304911

4. Install the delivery pipe assembly onto the cylinder head.

   Ensure that the injector can rotate smoothly. If not, remove the injector, check the O-ring for damage, replace the O-ring as required, then try to install the injector again.

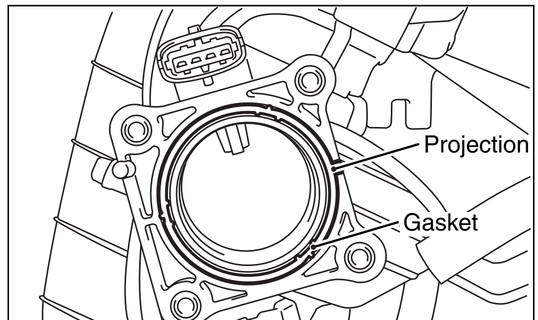
   Align the center of the injector with the center of the injector mounting hole in the delivery pipe and also aligning the protruded portions with each other.
5. The protruded portions can be aligned with each other by rotating the injector.
6. Tighten the delivery pipe assembly fittings to 18.4 ± 1.4 N·m.

>>B<< MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR INSTALLATION

⚠ CAUTION

- **Be careful not to provide shock to MAP sensor when installing it.**
- **If MAP sensor is dropped to the floor when installing it, discard it and use a new one.**

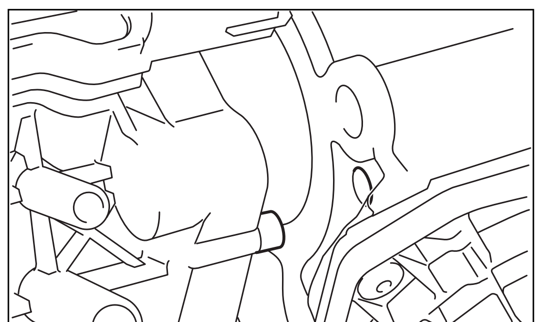
>>C<< THROTTLE BODY GASKET INSTALLATION



AK304912AD

Install the throttle body gasket, facing the gasket's protruded portion in the illustrated direction.

>>D<< THROTTLE BODY INSTALLATION



AK304913

Install the throttle body onto the inlet manifold, engaging the throttle body's recess with the manifold's protruded portion.

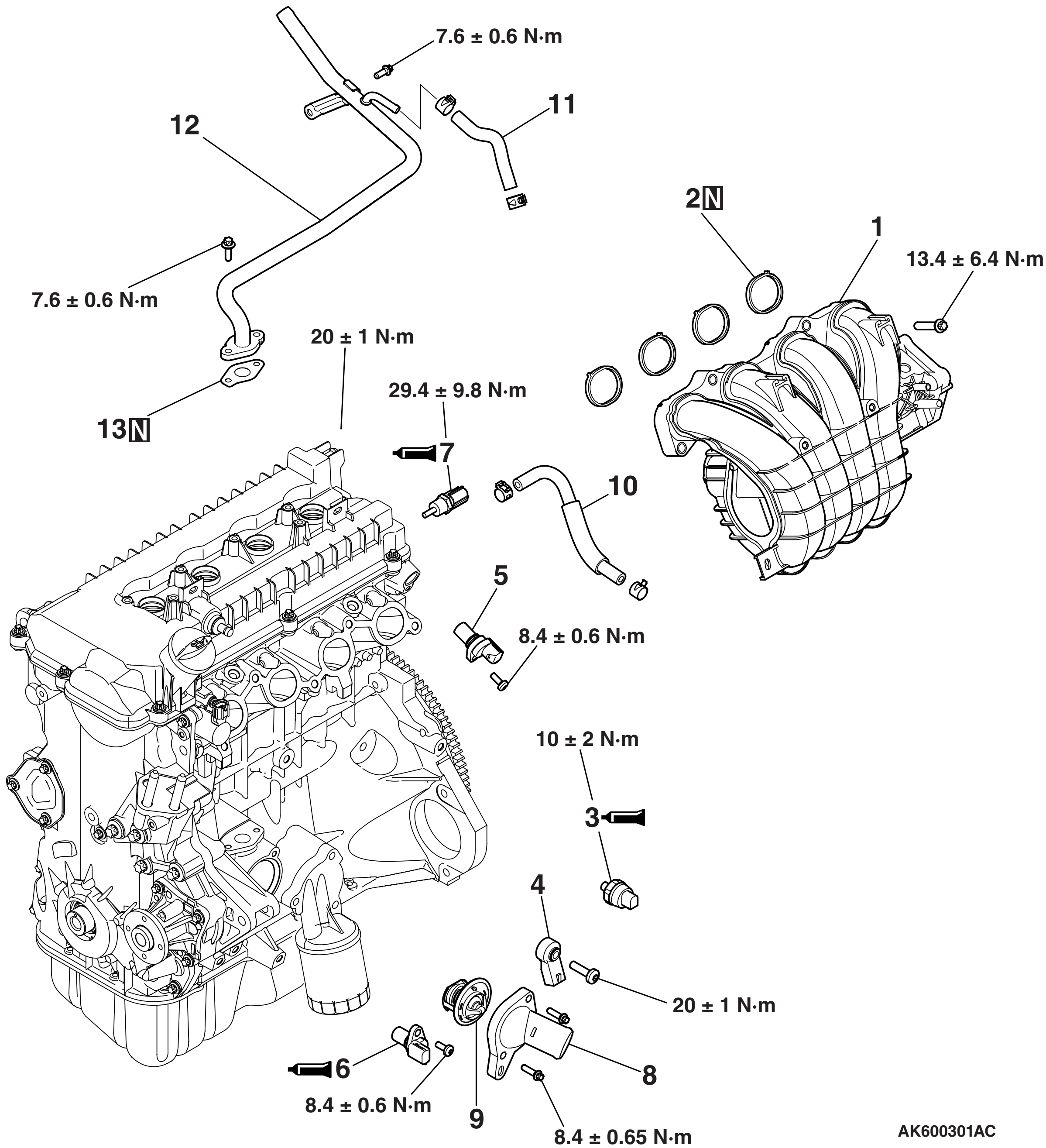
Main Index
Group TOC

INLET MANIFOLD

REMOVAL AND INSTALLATION

M1113026100385

<M/T>



Removal steps

1. Inlet manifold
2. Inlet manifold gasket

>>**E**<< 3. Oil pressure switch

4. Detonation sensor
5. Camshaft position sensor

>>**D**<< 6. Crank angle sensor

>>**C**<< 7. Engine coolant temperature sensor

Removal steps (Continued)

8. Water inlet fitting

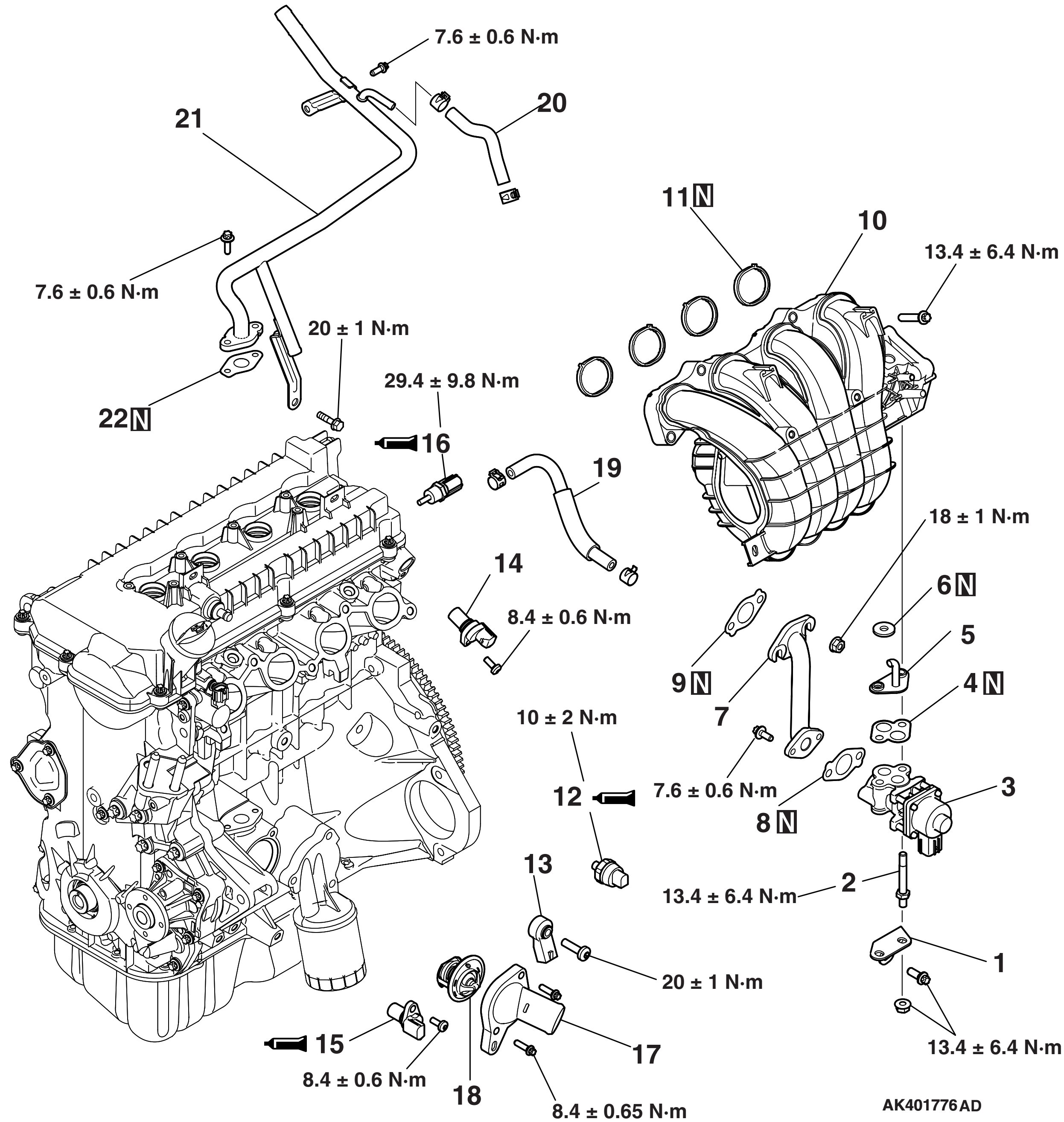
>>**B**<< 9. Thermostat

10. Water hose
11. Water hose

>>**A**<< 12. Water pipe assembly

13. Water pipe assembly gasket

<CVT>



Removal steps

1. Inlet manifold stay
2. Special bolt
3. EGR valve
4. >>**G**<< EGR valve gasket
5. EGR inlet pipe
6. Insulator gasket
7. EGR pipe
8. >>**F**<< EGR pipe gasket B
9. >>**F**<< EGR pipe gasket A
10. Inlet manifold
11. Inlet manifold gasket

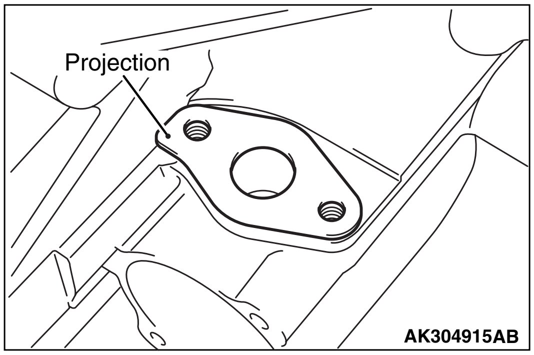
Removal steps (Continued)

12. >>**E**<< Oil pressure switch
13. Detonation sensor
14. Camshaft position sensor
15. >>**D**<< Crank angle sensor
16. >>**C**<< Engine coolant temperature sensor
17. Water inlet fitting
18. >>**B**<< Thermostat
19. Water hose
20. Water hose
21. >>**A**<< Water pipe assembly
22. Water pipe assembly gasket

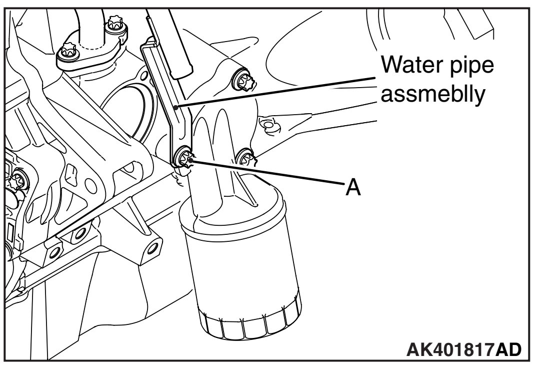
Main Index
Group TOC

INSTALLATION SERVICE POINTS

>>A<< WATER PIPE ASSEMBLY GASKET INSTALLATION

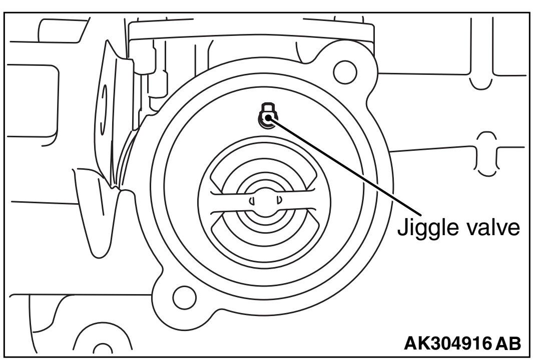


1. Place the water pipe assembly gasket onto the cylinder block, facing the gasket's protruded portion in the illustrated direction.



2. Tighten Bolt "A" shown in the illustration together with the oil filter bracket to the specified torque of 20 ± 1N·m.

>>B<< THERMOSTAT INSTALLATION

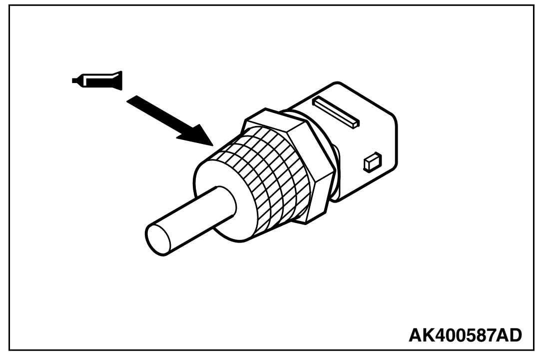


Install the thermostat onto the cylinder block such that the jiggle valve is positioned on top of the thermostat housing.

>>C<< ENGINE COOLANT TEMPERATURE SENSOR INSTALLATION

⚠ CAUTION

Be careful not to damage the connector portion (made of resin) of the sensor with the tool.



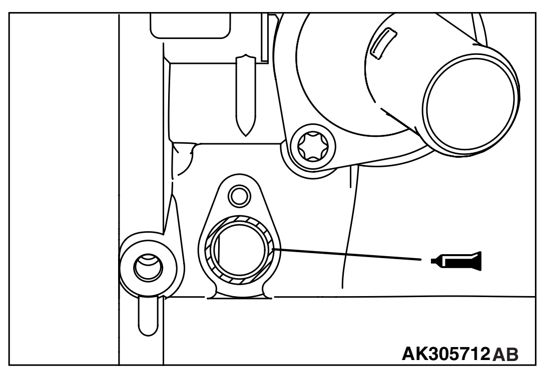
1. Remove any sealant that may be remaining on the engine coolant temperature sensor or the threaded hole in the cylinder head.
2. Apply sealant onto the threaded portion (illustrated) of the sensor.

   Specified sealant:
   LOCTITE 262 or equivalent
3. Install theengine coolant temperature sensor onto the cylinder block by tightening it to 29.4 ± 9.8 N·m.

>>D<< CRANK ANGLE SENSOR INSTALLATION

⚠ CAUTION

Apply sealant correctly so that it will not be squeezed out onto the end of the threaded portion upon assembly.



1. Remove any sealant that may be remaining on the angle sensor or the mounting face on the cylinder block.
2. Apply a bead of sealant with a diameter of 1.7 ± 0.5 mm on the cylinder block as illustrated.

   Specified sealant:
   LOCTITE 5971 or exact equivalent

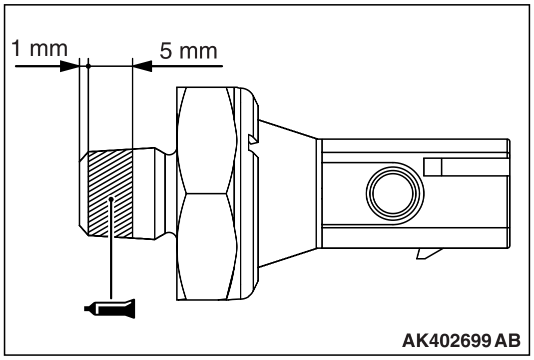
Main Index
Group TOC

3. Install the crank angle sensor onto the cylinder block by tightening it to 8.4 ± 0.6 N·m.

>>E<< OIL PRESSURE SWITCH INSTALLATION

⚠ CAUTION

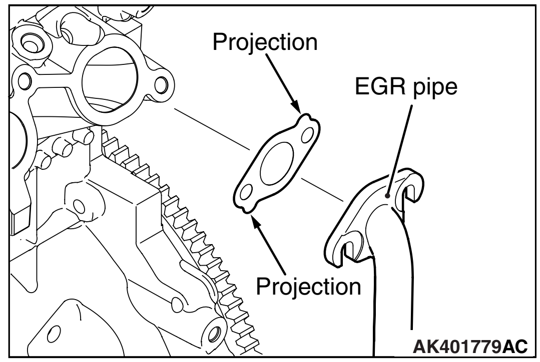
Apply sealant correctly so that it will not be squeezed out onto the end of the threaded portion upon assembly.



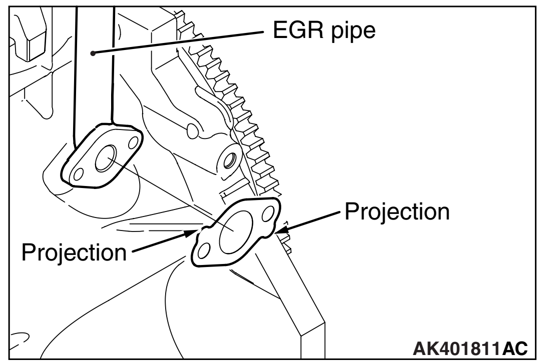
1. Remove any sealant that may be remaining on the oil pressure switch or the threaded hole in the cylinder block.
2. Apply sealant to the threaded portion of the oil pressure switch as illustrated.

   Specified sealant:
   LOCTITE 565 or equivalent
3. Install the oil pressure switch onto the cylinder block by tightening it to 10 ± 2 N·m.

>>F<< EGR PIPE GASKET INSTALLATION

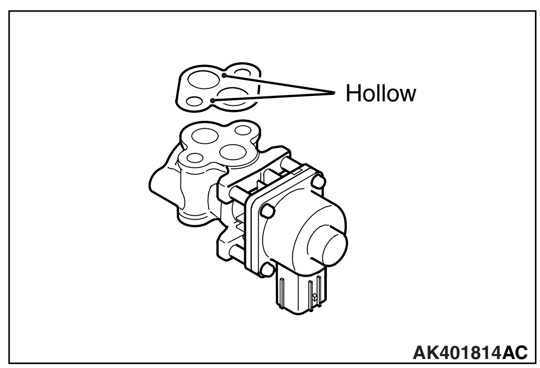


1. Install the EGR pipe gasket A, facing the gasket's protruded portion in the illudtrated direction.



2. Install the EGR pipe gasket B, facing the gasket's protruded portion in the illudtrated direction.

>>G<< EGR VALVE GASKET INSTALLATION



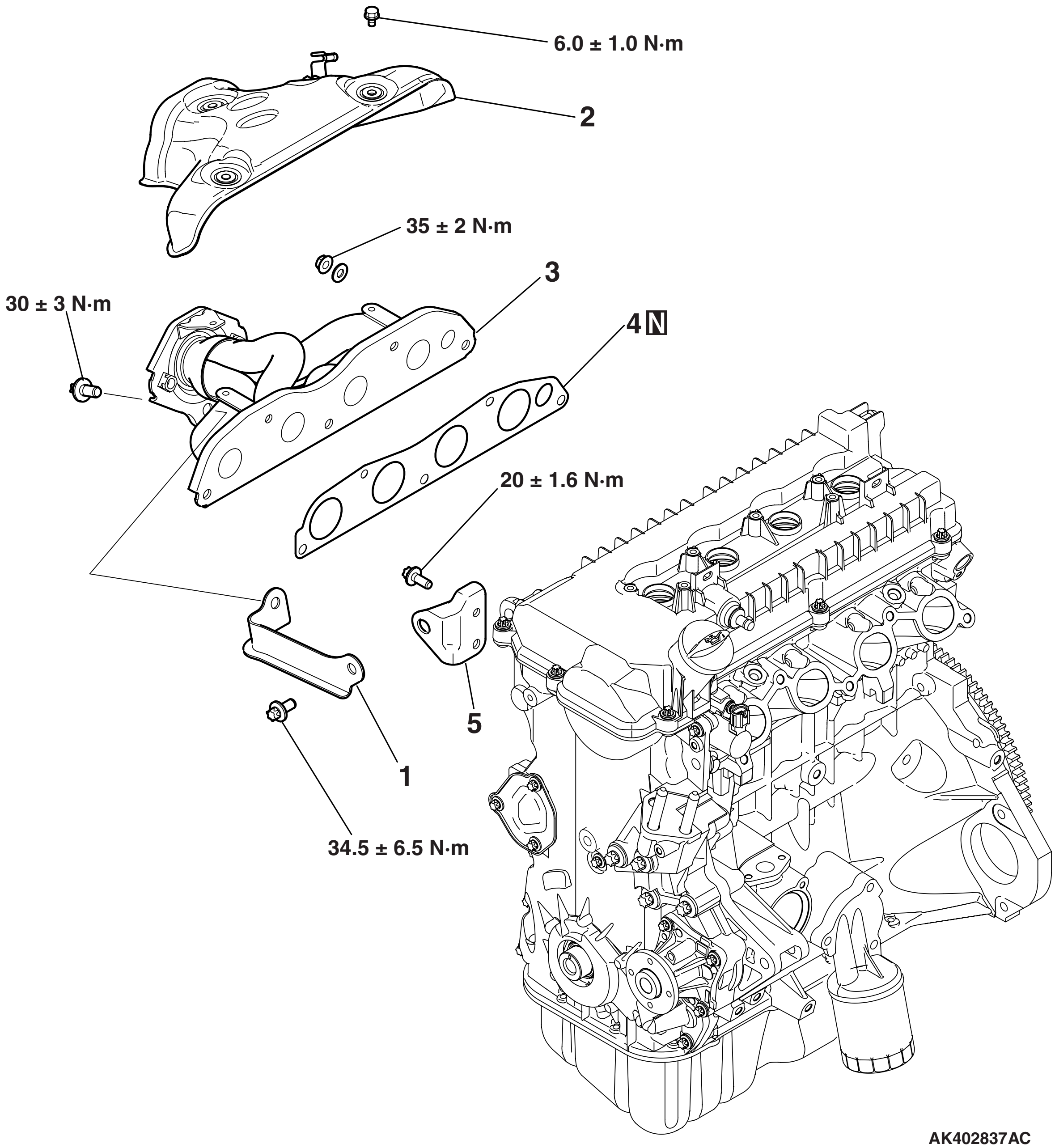
Install the EGR valve gasket, facing the gasket's hollow portion in the illudtrated direction.

Main Index
Group TOC

EXHAUST MANIFOLD

REMOVAL AND INSTALLATION

M1113004901171



Removal steps

>>**B**<< 1. Exhaust manifold bracket B
2. Heat protector
3. Exhaust manifold

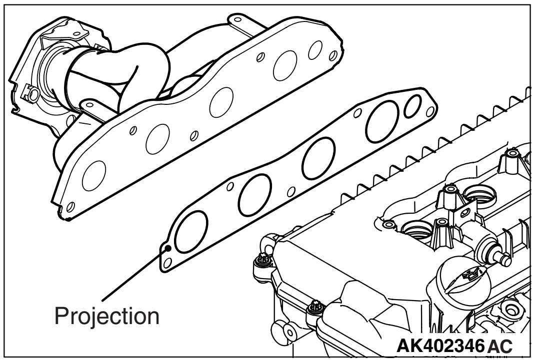
Removal steps (Continued)

>>**A**<< 4. Exhaust manifold gasket
5. Exhaust manifold bracket A

Main Index
Group TOC

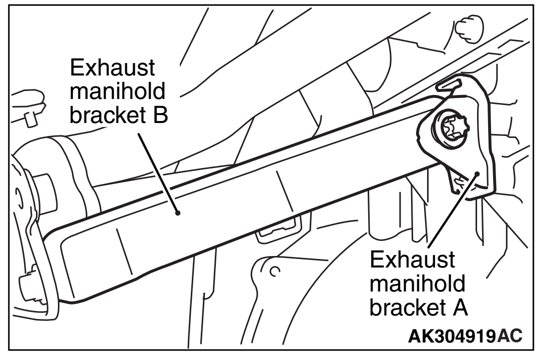
INSTALLATION SERVICE POINTS

>>A<< EXHAUST MANIFOLD GASKET INSTALLATION



Install the exhaust manifold gasket, facing the gasket's protruded portion in the illustrated direction.

>>B<< EXHAUST MANIFOLD BRACKET B INSTALLATION



Prior to installation, ensure that the exhaust manifold bracket B is closely seated onto the exhaust manifold and the exhaust manifold bracket A. Then, install the bracket B, tightening the fittings to 34.5 ± 6.5 N·m.

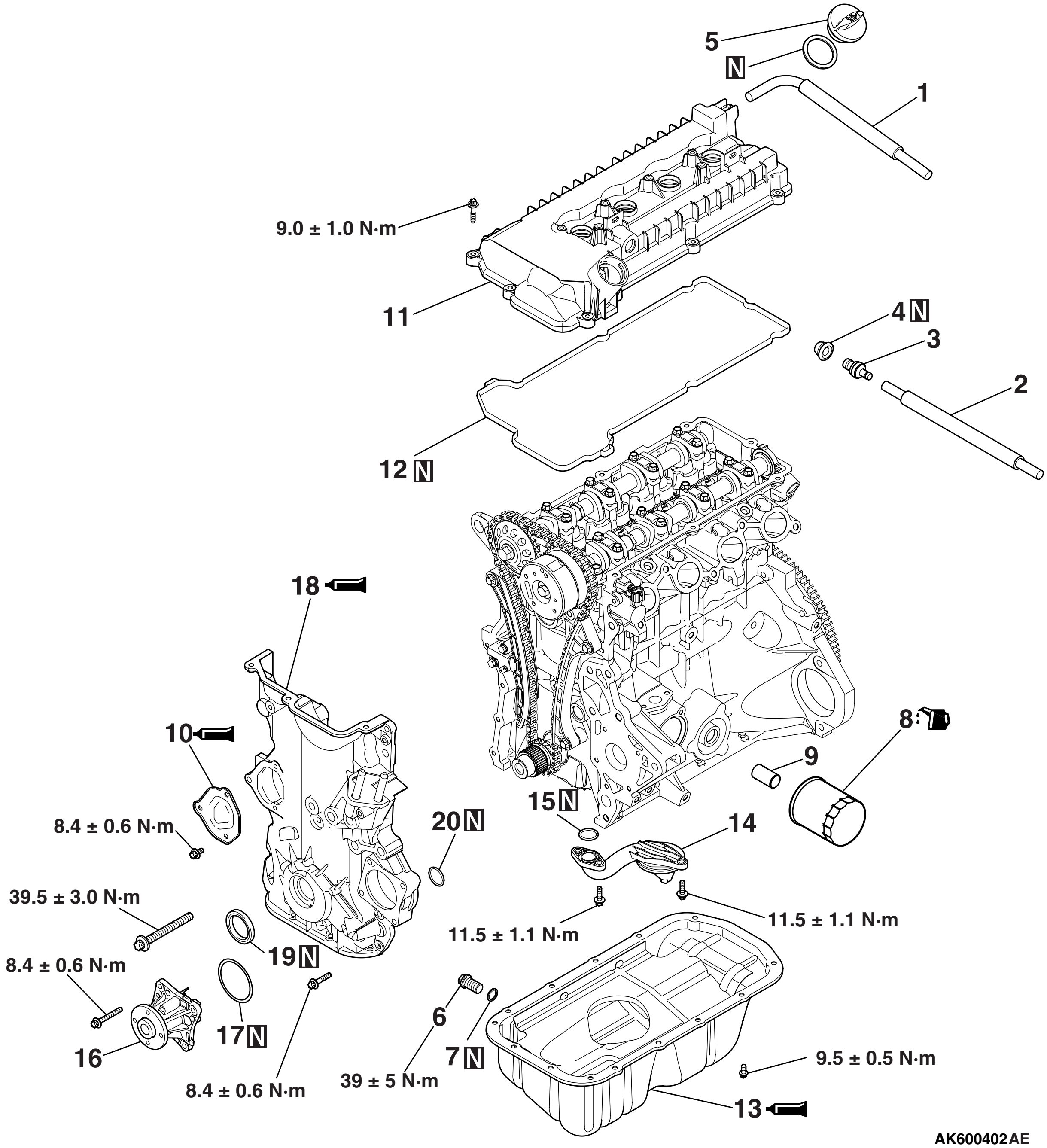
Main Index
Group TOC

OIL PAN AND TIMING CHAIN CASE

REMOVAL AND INSTALLATION

M1113026300282

<M/T>



Removal steps

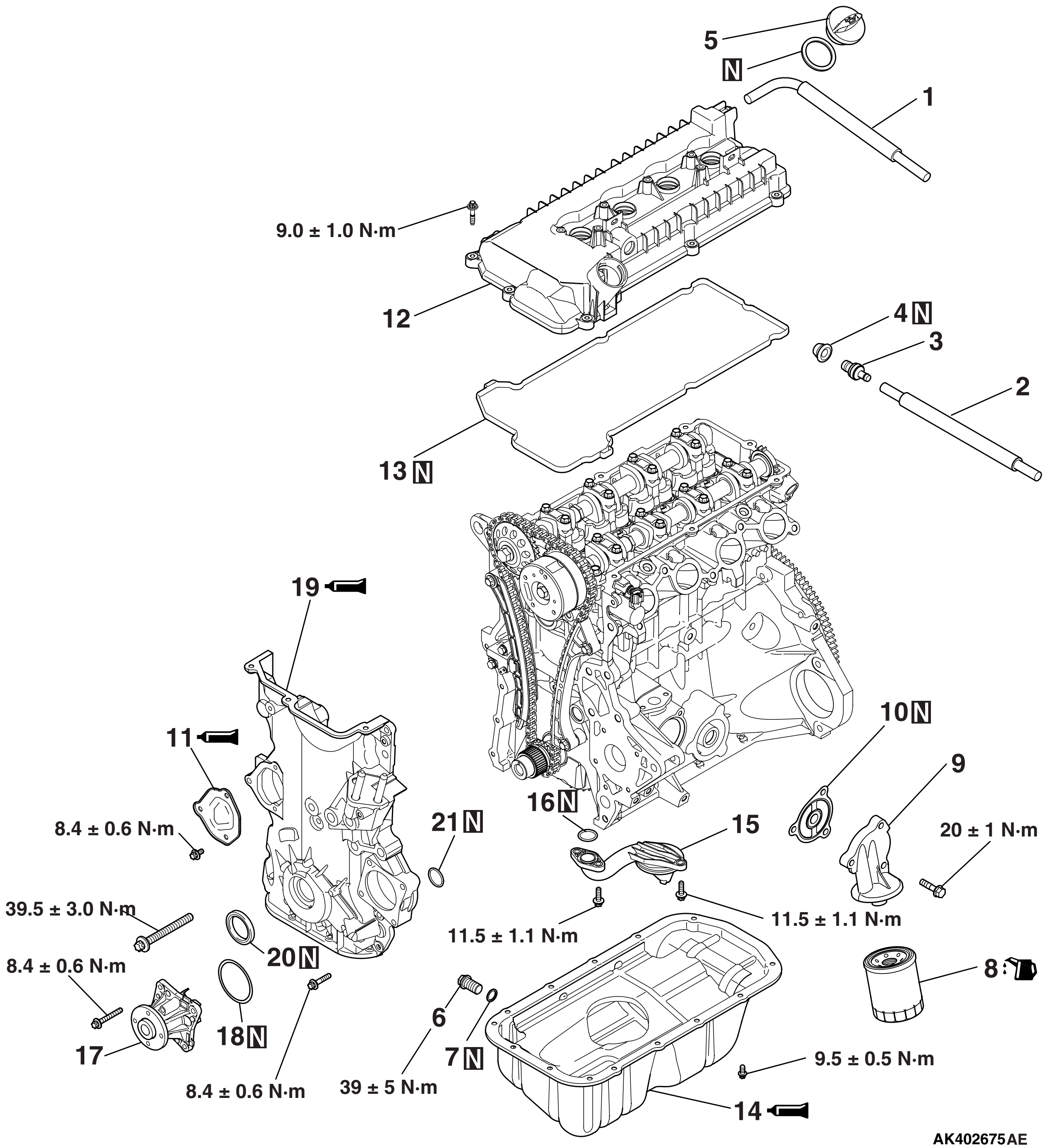
1. Breather hose
2. PCV hose
3. PCV valve
4. PCV valve gasket
5. Oil filler cap
6. Oil drain plug
7. Oil drain plug gasket
8. <<B>> >>F<< Oil filter
9. Oil filter stud
10. >>E<< Cover

Removal steps (Continued)

11. >>D<< Cylinder head cover
12. Cylinder head cover gasket
13. <<B>> >>C<< Oil pan
14. Oil screen
15. Oil screen gasket
16. Water pump
17. O-ring
18. >>B<< Timing chain case
19. >>A<< Front oil seal
20. O-ring

Main Index
Group TOC

<CVT>



Removal steps

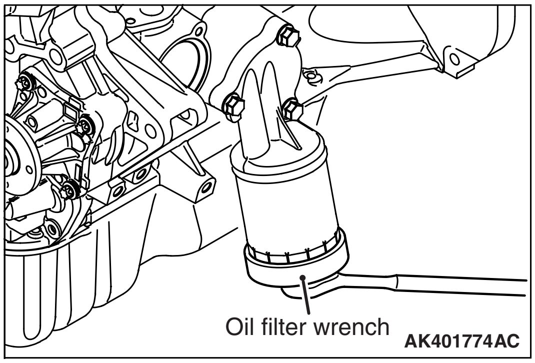
1. Breather hose
2. PCV hose
3. PCV valve
4. PCV valve gasket
5. Oil filler cap
6. Oil drain plug
7. Oil drain plug gasket
8. <<**A**>> >>**F**<< Oil filter
9. Oil filter bracket
10. Oil filter bracket gasket
11. >>**E**<< Cover

Removal steps (Continued)

12. >>**D**<< Cylinder head cover
13. Cylinder head cover gasket
14. <<**B**>> >>**C**<< Oil pan
15. Oil screen
16. Oil screen gasket
17. Water pump
18. O-ring
19. >>**B**<< Timing chain case
20. >>**A**<< Front oil seal
21. O-ring

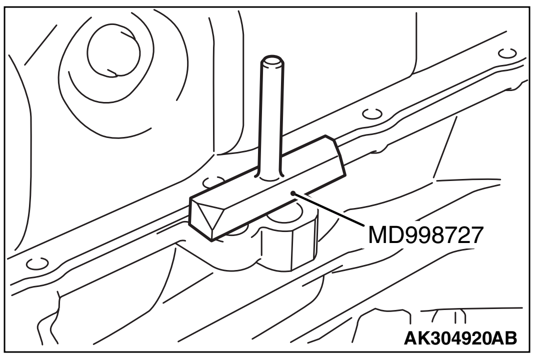
REMOVAL SERVICE POINTS

<<A>> OIL FILTER REMOVAL



Remove the oil filter using an oil filter wrench (commercially available).

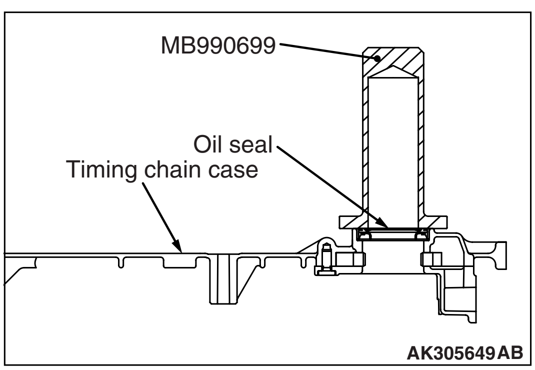
<<B>> OIL PAN REMOVAL



1. Remove the oil pan retaining bolts.
2. Knock the special tool Oil pan cutter (MD998727) between the oil pan and the cylinder block.

INSTALLATION SERVICE POINTS

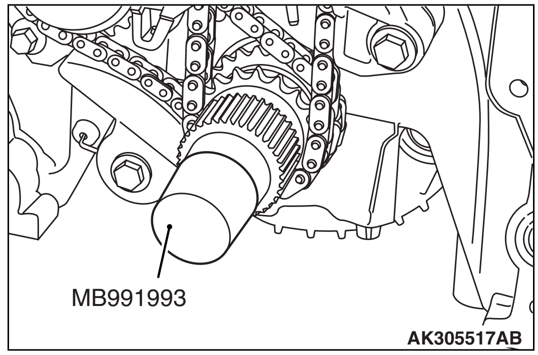
>>A<< FRONT OIL SEAL INSTALLATION



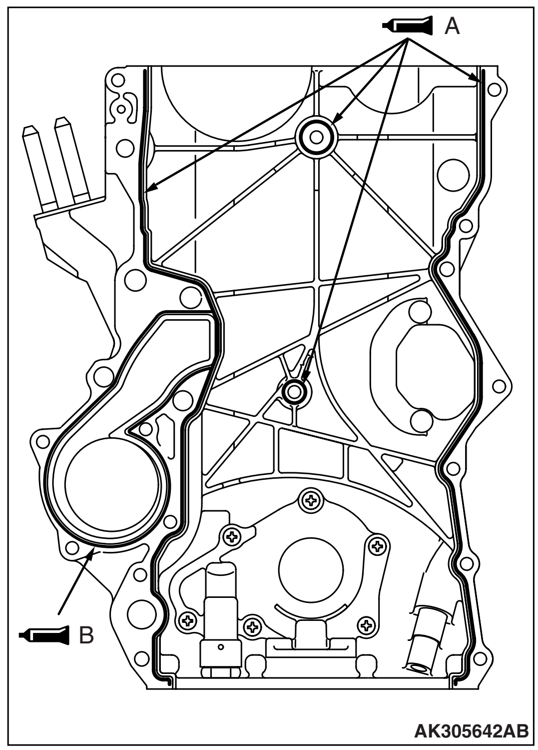
Install the front oil seal into the timing chain case using the special tool Differential oil seal installer (MB990699).

>>B<< TIMING CHAIN CASE INSTALLATION

1. Remove any liquid gasket remaining on the timing chain case, the cylinder block, and the cylinder head.



2. Install the special tool Oil seal guide (MB991993) onto the crankshaft.



⚠ CAUTION

The timing chain case should be installed within 3 minutes of applying liquid gasket.

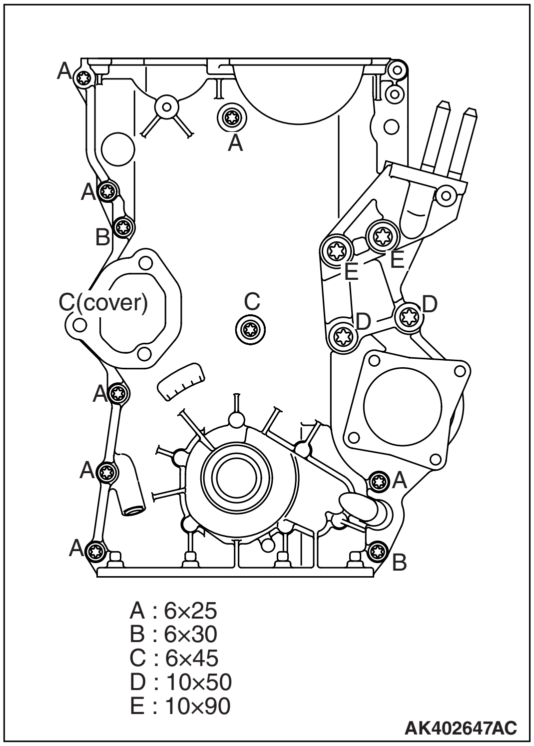
3. Apply a 2.0 ± 0.5 mm bead of liquid gasket to location A, and a 1.5 ± 0.5 mm bead of liquid gasket to location B on the timing chain case respectively as illustrated.

   Specified sealant:
   LOCTITE 5971 or exact equivalent

4. Install the timing chain case.

   NOTE: The retaining bolts have different lengths. Be sure to use the correct bolt for each location.

Main Index
Group TOC



5. Tighten the chain case retaining bolts to the specified torques.

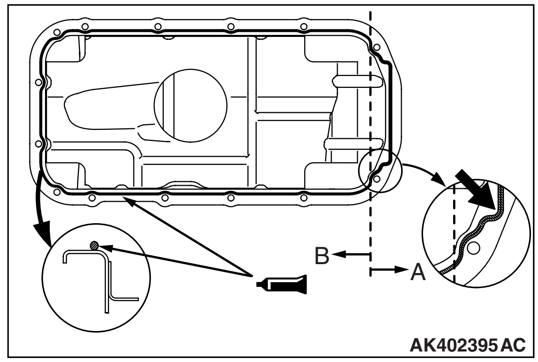
Tightening torque:
M6 8.4 ± 0.6 N·m
M10 39.5 ± 3.0 N·m

>>C<< OIL PAN INSTALLATION

1. Remove any liquid gasket remaining on the cylinder block, the timing chain case, the oil seal case and the oil pan.

⚠ CAUTION

The oil pan should be installed within 3 minutes of applying liquid gasket.



2. Apply a 4.0 ± 0.5 mm bead of liquid gasket to location A, and a 2.0 ± 0.5 mm bead of liquid gasket to location B on the oil pan respectively as illustrated.

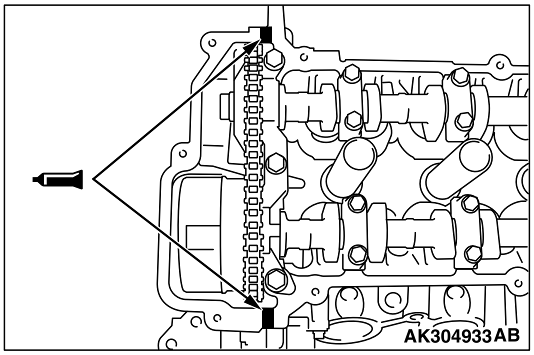
   Specified sealant:
   LOCTITE 5971 or exact equivalent

3. Install the oil pan by tightening the fittings to 9.5 ± 0.5 N·m.

Main Index
Group TOC

>>D<< CYLINDER HEAD COVER INSTALLATION

1. Remove any liquid gasket remaining on the cylinder head cover, the timing chain case and the cylinder head.

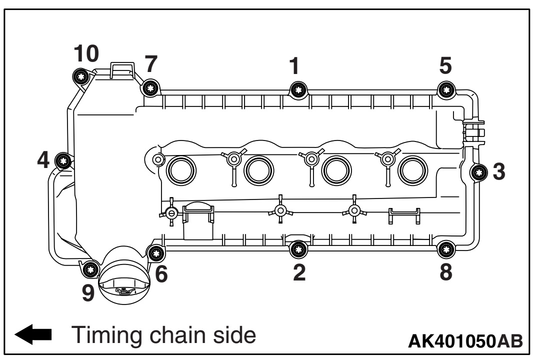


⚠ CAUTION

The timing chain should be installed within 3 minutes of applying liquid gasket.

2. Apply a 4 mm bead of liquid gasket as illustrated.

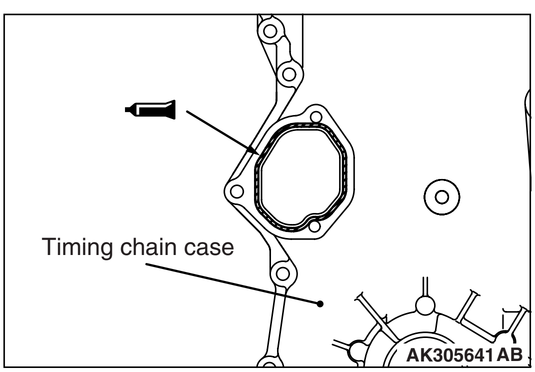
Specified sealant:
LOCTITE 5971 or exact equivalent



3. In accordance with the procedure shown in Figure, tighten the bolt of the cylinder head cover to 9.0 ± 1.0 N·m.

>>E<< COVER INSTALLATION

1. Remove any liquid gasket remaining on the timing chain case and the cover.



⚠ CAUTION

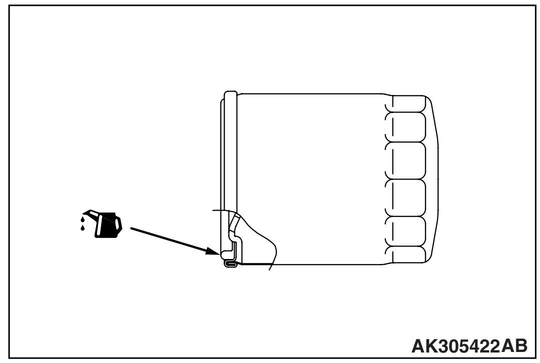
The cover should be installed within 3 minutes of applying liquid gasket.

2. Apply a 2.0 ± 0.5 mm bead of liquid gasket as illustrated.

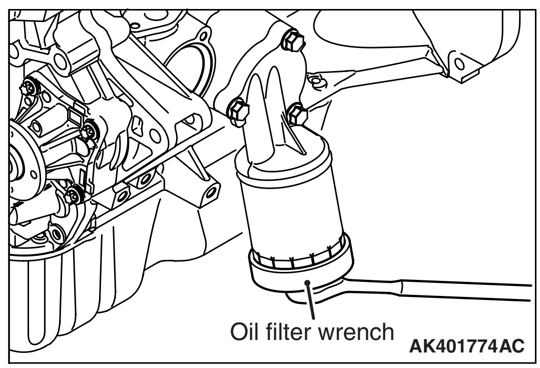
Specified sealant:
LOCTITE 5971 or exact equivalent

>>F<< OIL FILTER INSTALLATION

1. Clean the filter mounting surface on the cylinder block.



2. Apply engine oil to the oil filter gasket as shown in the drawing.



⚠ CAUTION

Tighten the oil filter using a filter wrench (commercially available). Manual tightening cannot generate the required torque, leading to oil leakage.

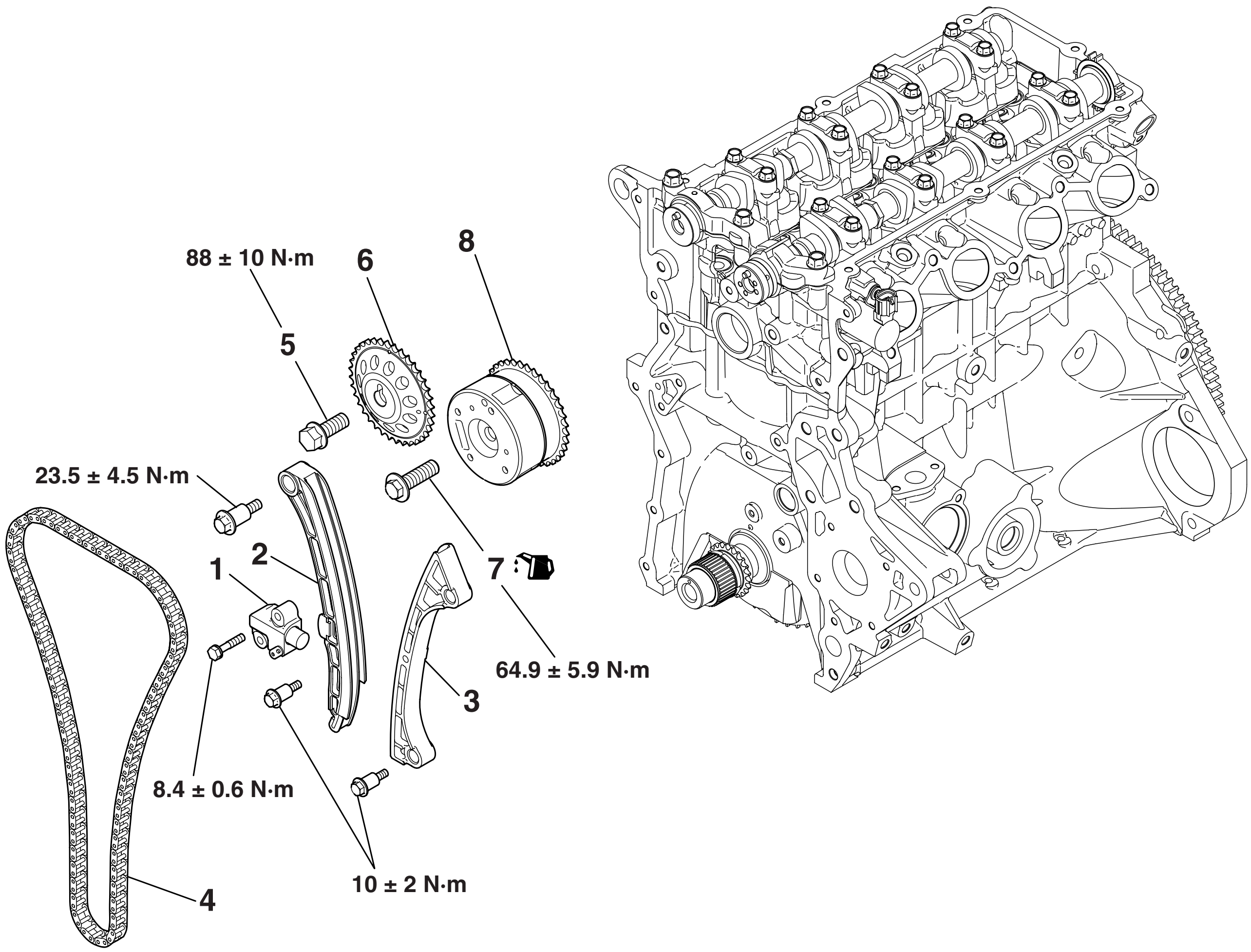
3. Screw in the oil filter until the O-ring contacts the mounting surface. Further tighten by 3/4 of a turn or to 11 ± 1 N·m using a filter wrench.

Main Index
Group TOC

TIMING CHAIN

REMOVAL AND INSTALLATION

M1113026600216



Removal steps

>>**D**<<	1.	Timing chain tensioner assembly
	2.	Tensioner lever assembly
	3.	Chain guide assembly
>>**C**<<	4.	Timing chain
<<**A**>> >>**B**<<	5.	Camshaft sprocket bolt

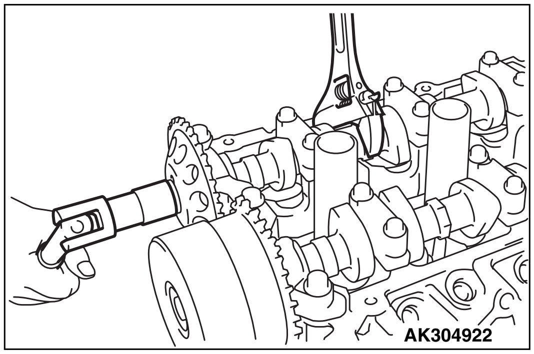
Removal steps (Continued)

	6.	Camshaft sprocket
<<**B**>> >>**A**<<	7.	V.V.T. sprocket bolt
	8.	V.V.T. sprocket assembly

Main Index
Group TOC

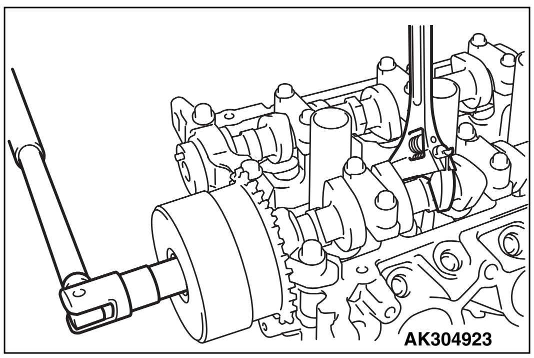
REMOVAL SERVICE POINTS

<<A>> CAMSHAFT SPROCKET BOLT REMOVAL



While holding the hexagonal portion of the camshaft with a wrench, remove the camshaft sprocket bolt.

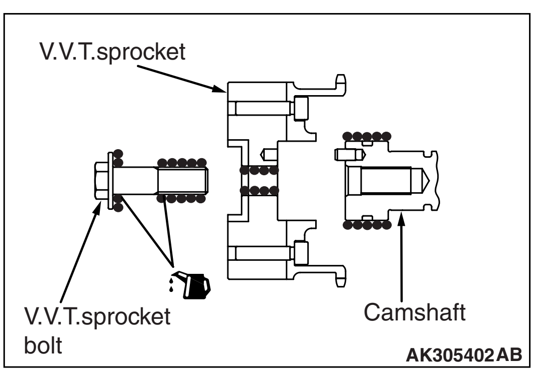
<<B>> V.V.T. SPROCKET BOLT REMOVAL



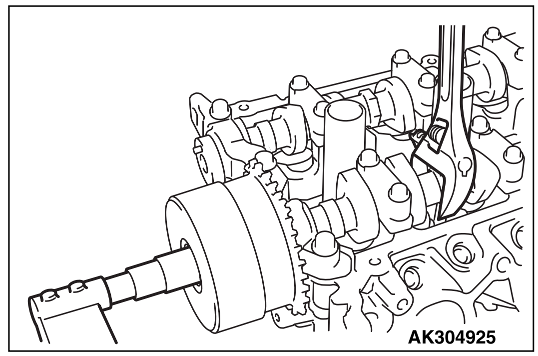
While holding the hexagonal portion of the camshaft with a wrench, remove the V.V.T. sprocket bolt.

INSTALLATION SERVICE POINTS

>>A<< V.V.T. SPROCKET BOLT INSTALLATION

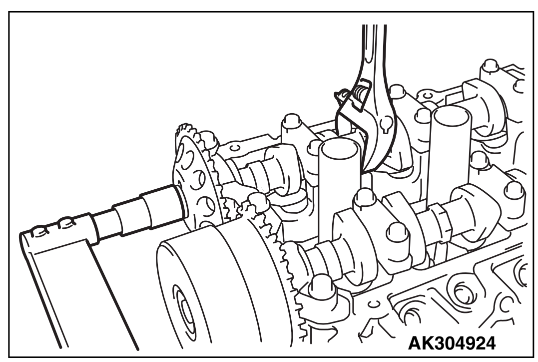


1. Apply a proper minimum quantity of engine oil to the following points.
   - Camshaft end
   - Insertion hole in V.V.T. sprocket (all over inside and outside surfaces)
   - Threads and head of V.V.T. sprocket bolt
   - Bearing surface of V.V.T. sprocket bolt
2. Install the V.V.T. sprocket onto the camshaft.
3. Make sure that the V.V.T. sprocket is installed all the way onto the camshaft. Holding the hexagonal portion of the camshaft with a wrench, check that the V.V.T. sprocket does not turn.



4. While holding the hexagonal portion of the camshaft with a wrench, tighten the V.V.T. sprocket bolt to 64.9 ± 5.9 N·m.

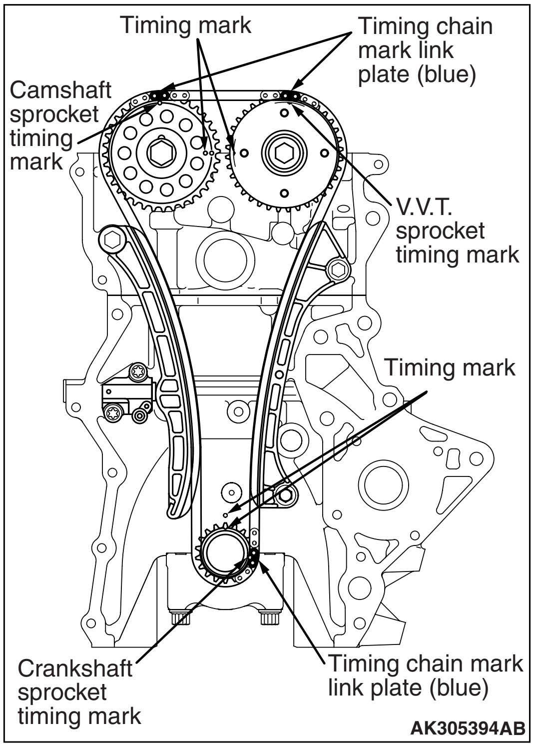
>>B<< CAMSHAFT SPROCKET BOLT INSTALLATION



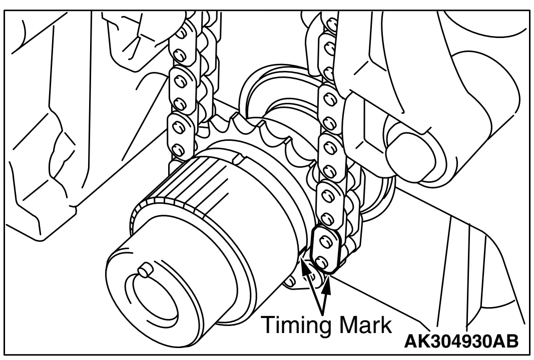
While holding the hexagonal portion of the camshaft with a wrench, tighten the sprocket bolt to 88 ± 10 N·m.

Main Index
Group TOC

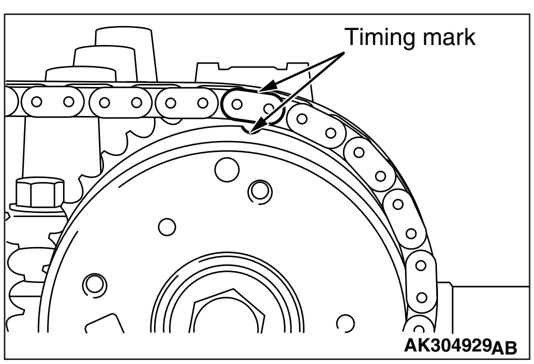
>>C<< TIMING CHAIN INSTALLATION



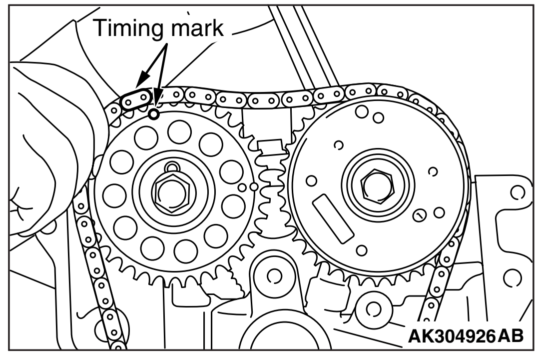
1. Place the timing chain such that the blue link that is away from the other two blue links of the chain is on the crankshaft side.



2. Install the timing chain onto the crankshaft sprocket, aligning the blue link with the mark on the sprocket.



3. Install the chain onto the V.V.T. sprocket, aligning the blue link with the mark on the sprocket.

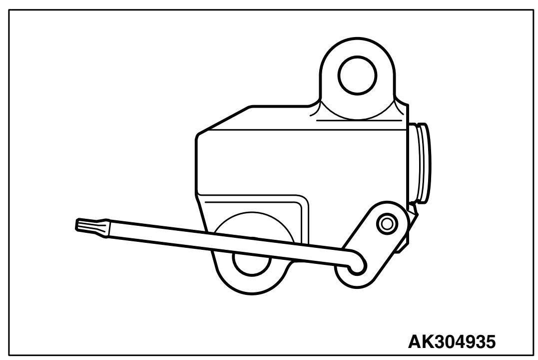


4. Install the chain onto the camshaft sprocket, aligning the blue link with the mark on the sprocket.

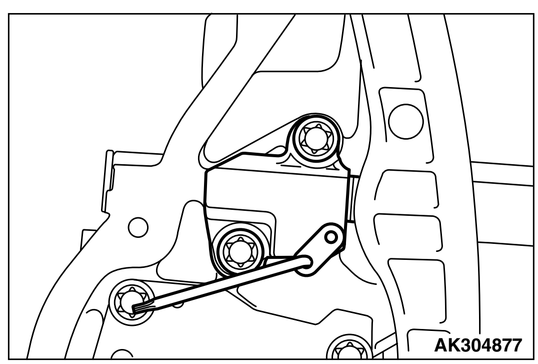
   When doing this, rotate the V.V.T. sprocket or the camshaft sprocket by a tooth or two and then align the blue link and the mark.
5. Ensure that all of the 3 pairs of the timing marks are aligned.
6. Install the chain guide and the tensioner lever.

>>D<< TIMING CHAIN TENSIONER INSTALLATION

1. While pressing in the plunger of the timing chain tensioner, insert the pin as illustrated to lock the plunger.



2. Install the timing chain tensioner onto the cylinder block, timing chain Tensioner bolts to 8.4 ± 0.6 N·m.



3. Remove the pin from the tensioner. Timing chain should be tensioned via the tensioner lever.

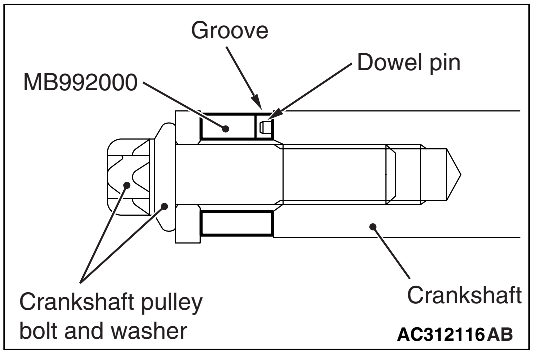
Main Index
Group TOC

INSPECTION

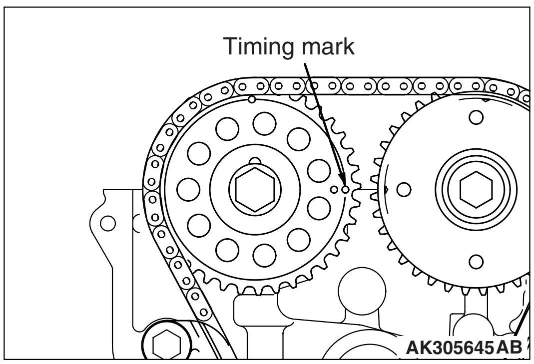
M1113026700075

VALVE CLEARANCE MEASUREMENT

Measure the valve clearance as illustrated.



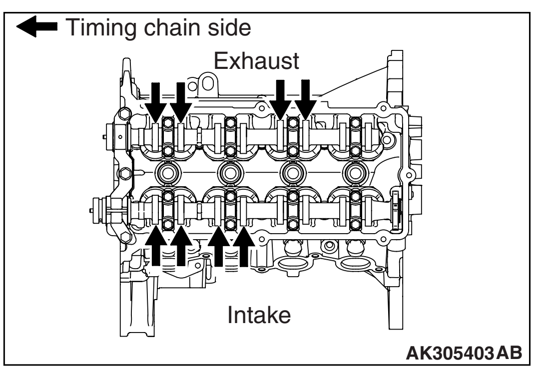
Set the special tool Crankshaft adapter (MB992000) to the crankshaft, and install the crankshaft pulley bolt and washer.



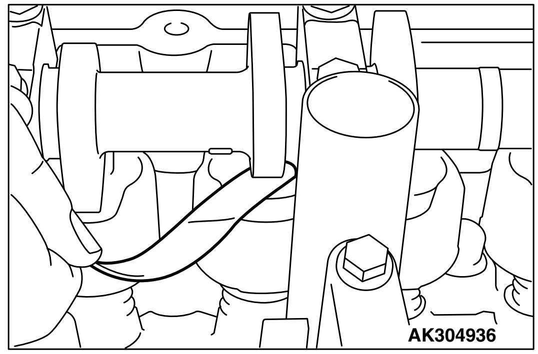
⚠ **CAUTION**

The crankshaft should always be rotated clockwise.

1. Rotate the crankshaft clockwise until the mark on the camshaft sprocket is aligned with the mark on the upper surface of cylinder head. (Set the No. 1 cylinder to TDC on the compression stroke.)



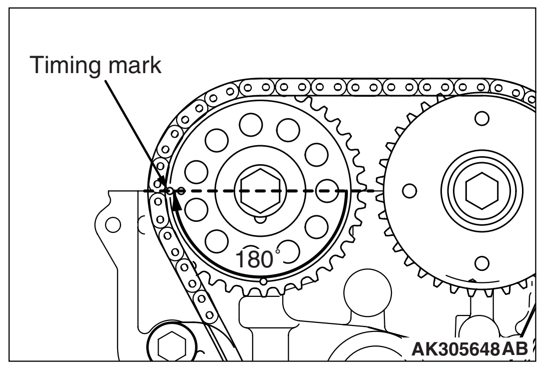
2. Now, the valve clearance (shown with an arrow) can be measured.



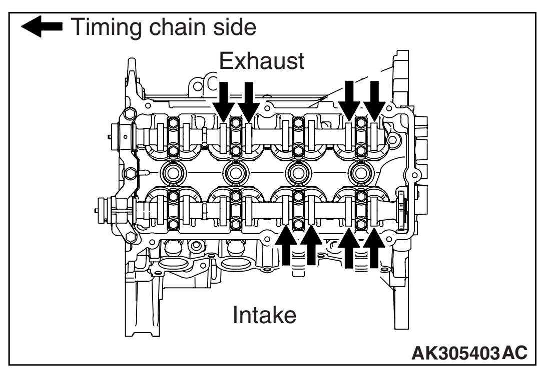
3. Using a thickness gauge, measure the clearance between the cam base circle and the valve tappet.

   Standard value (cold engine):
   Intake valve 0.22 ± 0.04 mm
   Exhaust valve 0.30 ± 0.04 mm

4. If the measured value does not conform to the standard value, record the measured value.



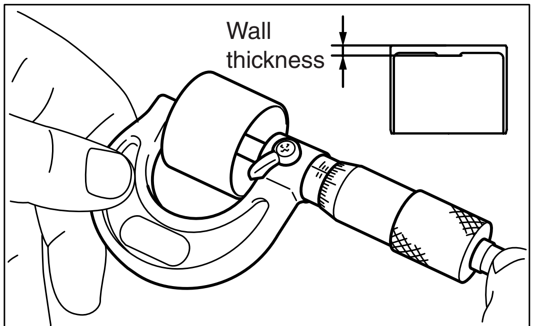
5. Rotate the crankshaft clockwise until the mating mark on the camshaft sprocket comes to the illustrated location. This will bring the No. 4 cylinder to TDC on the compression stroke.



6. Measure the valve clearance at the location shown with an arrow.
7. If the measured value does not conform to the standard value, record the measured value.
8. Replace the valve tappet for the valve whose clearance is out of the standard value.

Main Index
Group TOC

NOTE: Valve tappets are available in 31 sizes, at 0.02 mm intervals in the 2.70 – 3.30 mm range.



AK304938 AB

9. Valve tappets should be selected in the following manner.
   (1) Remove the valve tappet and measure its thickness.
   (2) Calculate the correct thickness for a new valve tappet as follows that achieves the standard valve clearance.

A: Thickness of new valve tappet
B: Thickness of old valve tappet
C: Measured valve clearance

Equation:
Intake valve A = B + (C – 0.22 mm)
Exhaust valve A = B + (C – 0.30 mm)

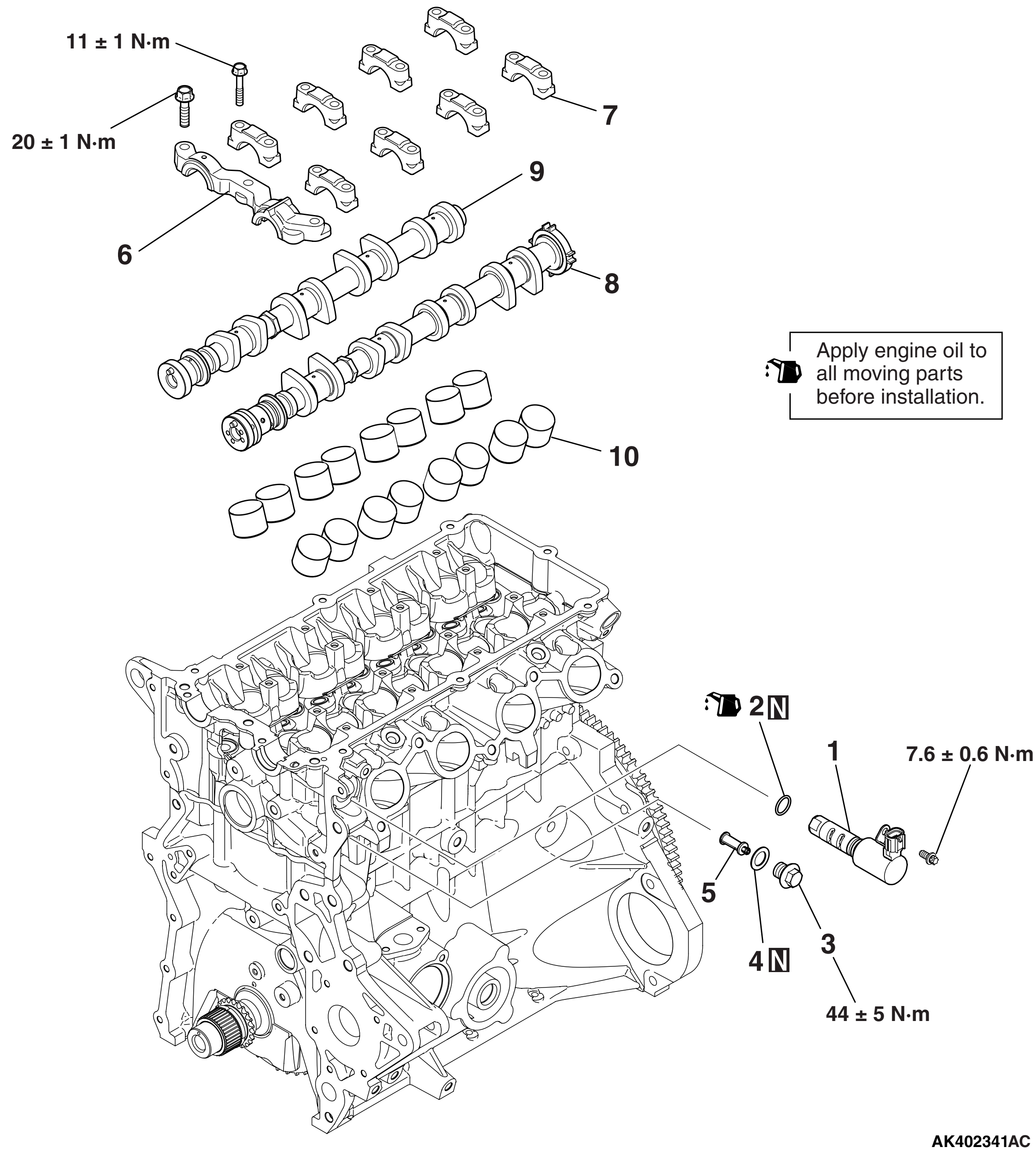
For removal and installation procedures for the valve tappet, refer to "CAMSHAFT REMOVAL AND INSTALLATION."
(Refer to Camshaft Removal and Installation.P.11B-29)

Main Index
Group TOC

CAMSHAFT

REMOVAL AND INSTALLATION

M1113026900110



Removal steps

	>>D<<	1.	Oil feeder control valve (OCV)
	>>D<<	2.	O-ring
		3.	Oil feeder control valve (OCV) filter bolt
		4.	Gasket
	>>C<<	5.	Oil feeder control valve (OCV) filter
<<A>>	>>B<<	6.	Front camshaft bearing cap

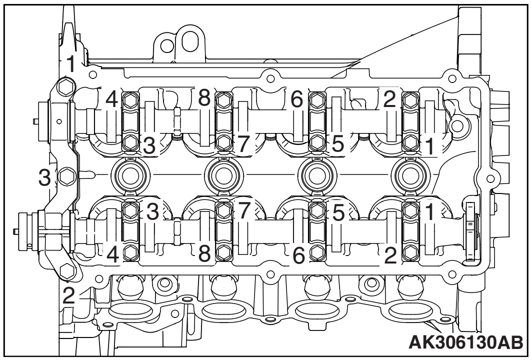
Removal steps (Continued)

<<A>>	>>B<<	7.	Camshaft bearing cap
	>>B<<	8.	Camshaft, intake
	>>B<<	9.	Camshaft, exhaust
<<B>>	>>A<<	10.	Valve tappet

Main Index
Group TOC

REMOVAL SERVICE POINTS

<<A>> FRONT CAMSHAFT BEARING CAP / CAMSHAFT BEARING CAP REMOVAL



In accordance with the numerical order shown in the illustration, remove the front camshaft bearing cap first, and then remove the installation bolt of each camshaft bearing cap.

<<B>> VALVE TAPPET REMOVAL

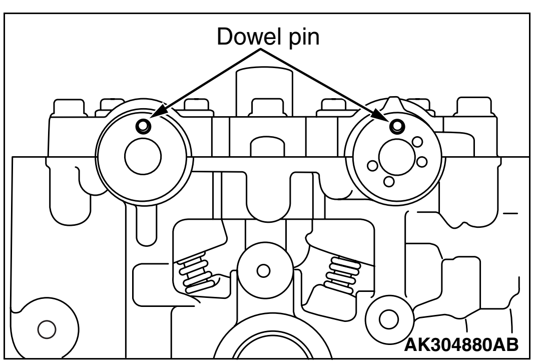
To facilitate reassembly, attach a tag to each valve tappet removed that shows where it has been assembled.

INSTALLATION SERVICE POINTS

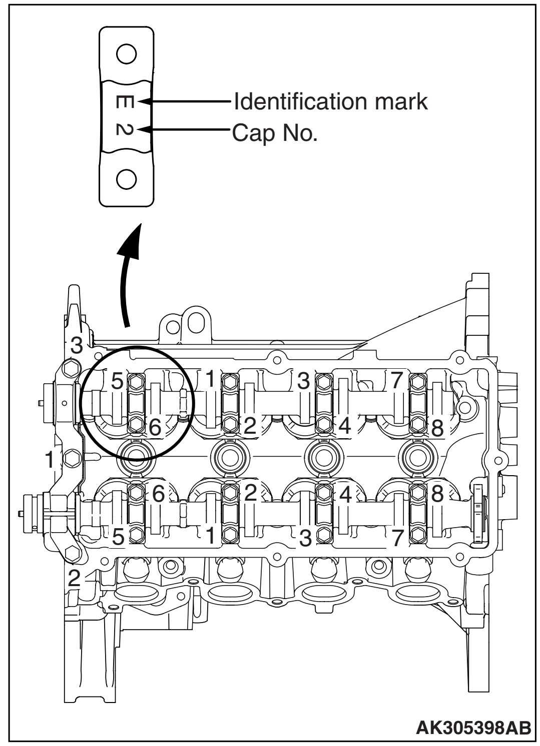
>>A<< VALVE TAPPET INSTALLATION

Reassemble each valve tappet to the correct location shown on the tag.

>>B<< CAMSHAFT/CAMSHAFT BEARING CAP INSTALLATION



1. Install each camshaft, ensuring that the dowel pin faces the illustrated direction.



2. The No. 2 to No. 5 bearing caps are equally shaped for both the intake and exhaust camshafts. Be sure to correctly install them by referring to the identification marks.

   Identification mark (stamped on the front and No. 2 to No. 5 bearing caps)

   I: Intake

   E: Exhaust

3. In accordance with the numerical order shown in the illustration, tighten each camshaft bearing cap first and then tighten the front camshaft bearing cap in several steps.

>>C<< OIL FEEDER CONTROL VALVE (OCV) FILTER INSTALLATION

⚠ CAUTION

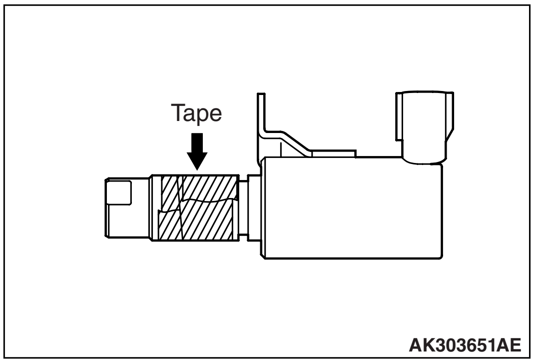
After checking for foreign matters attached, defects and deformation, install the oil feeder control valve filter.

Main Index
Group TOC

>>D<< OIL FEEDER CONTROL VALVE (OCV) INSTALLATION

⚠ CAUTION

- **Do not reuse the O-ring.**
- **Install the O-ring after wrap a tape not having adhesion (such as a seal tape) round the notch on the oil passage of OCV to prevent it from damage. The damaged O-ring may cause oil leakage.**



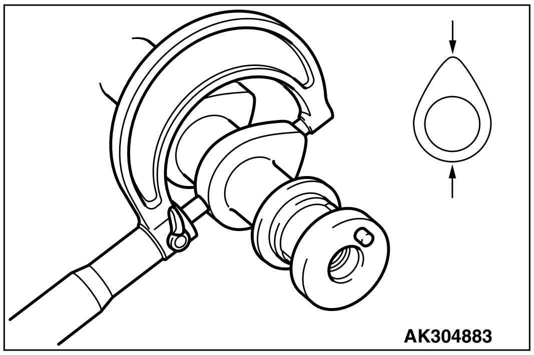
1. Apply a little amount of engine oil to the O-ring of OCV.
2. Install the OCV to the cylinder head.
3. Tighten the OCV to the specified torque of 7.6 ± 0.6 N·m.

Main Index
Group TOC

INSPECTION

M1113027000091

CAMSHAFT

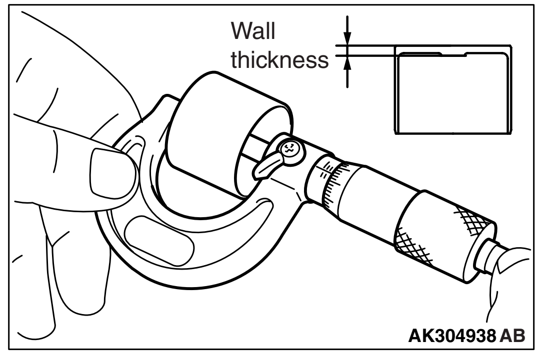


Measure the cam height. If the measured value exceeds the limit, replace the camshaft.

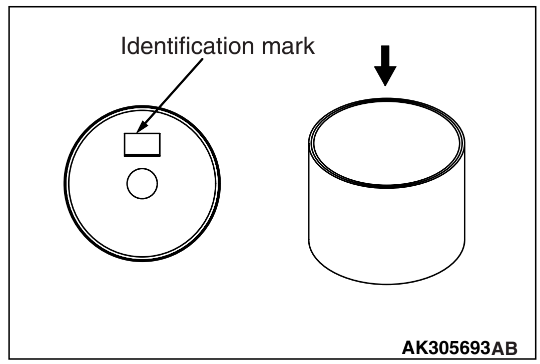
Standard value:
Intake: 44.71 mm
Exhaust: 44.28 mm

Limit:
Intake: 44.21 mm
Exhaust: 43.78 mm

VALVE TAPPET



1. Measure the valve tappet at the illustrated location. If the measured valve is discord to instruction valve by identification mark and following table, replace the tappet.



2. Every valve tappet has an identification mark stamped at the illustrated location.

   Valve tappets are available in 31 sizes, at 0.02 mm intervals in the 2.70 – 3.30 mm range, as shown in the following table.

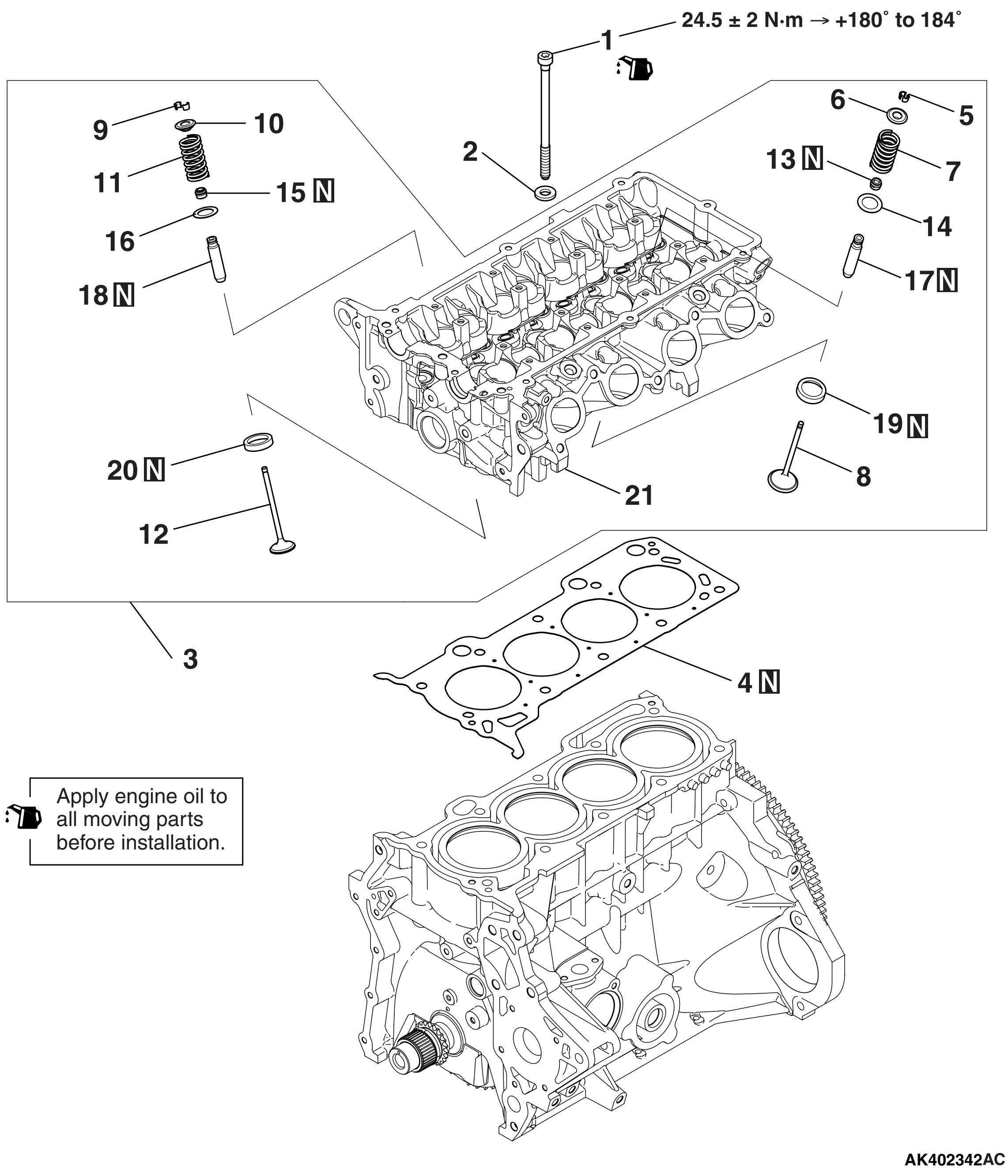
Thickness mm	ID mark	Thickness mm	ID mark	Thickness mm	ID mark
2.70	70	2.92	92	3.14	14
2.72	72	2.94	94	3.16	16
2.74	74	2.96	96	3.18	18
2.76	76	2.98	98	3.20	20
2.78	78	3.00	00	3.22	22
2.80	80	3.02	02	3.24	24
2.82	82	3.04	04	3.26	26
2.84	84	3.06	06	3.28	28
2.86	86	3.08	08	3.30	30
2.88	88	3.10	10		
2.90	90	3.12	12		

Main Index
Group TOC

CYLINDER HEAD AND VALVES

REMOVAL AND INSTALLATION

M1113006900992



Removal steps

- >>**C**<< 1. Cylinder head bolt
- 2. Cylinder head bolt washer
- 3. Cylinder head assembly
- 4. Cylinder head gasket
- <<**A**>> >>**B**<< 5. Retainer lock
- 6. Valve spring retainer
- 7. Valve spring
- 8. Intake valve
- <<**A**>> >>**B**<< 9. Retainer lock
- 10. Valve spring retainer
- 11. Valve spring

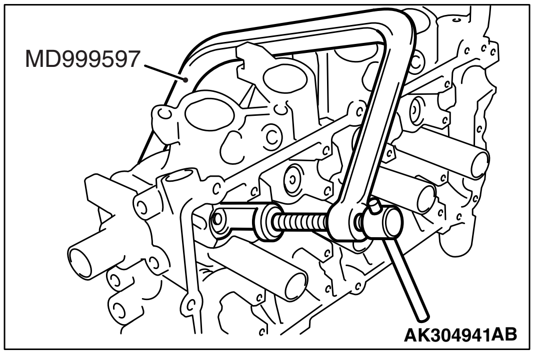
Removal steps (Continued)

- 12. Exhaust valve
- >>**A**<< 13. Valve stem seal
- 14. Valve spring seat
- >>**A**<< 15. Valve stem seal
- 16. Valve spring seat
- 17. Valve guide
- 18. Valve guide
- 19. Intake valve seat
- 20. Exhaust valve seat
- 21. Cylinder head

Main Index
Group TOC

REMOVAL SERVICE POINTS

<<A>> RETAINER LOCK REMOVAL

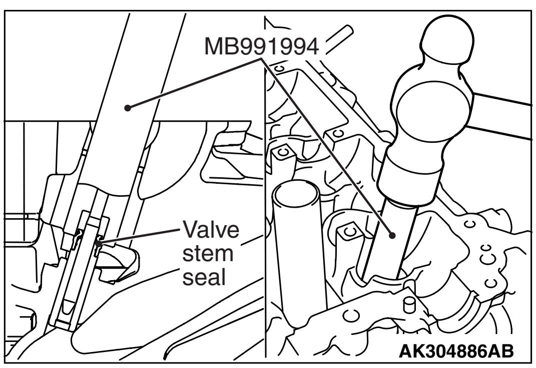


While compressing the valve spring using the special tool Valve spring compressor (MD999597), remove the retainer lock.

NOTE: To facilitate reassembly, the valve, spring and other parts removed should be kept together and attached with a tag showing where it has been assembled including the cylinder number.

INSTALLATION SERVICE POINTS

>>A<< VALVE STEM SEAL INSTALLATION



1. Install the valve spring seat.

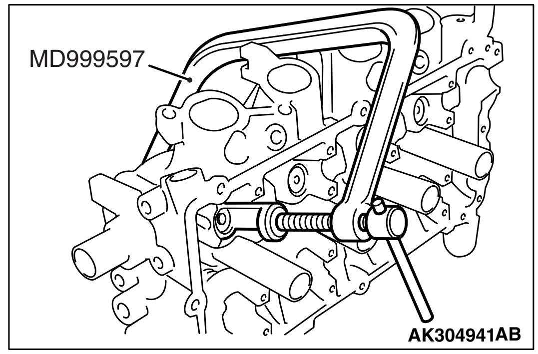
⚠ CAUTION

- **The valve stem seal should not be reused.**
- **A new valve stem seal should be installed correctly using the special tool. Incorrectly installed valve stem seal will allow engine oil to leak through into the combustion chamber.**

2. Lightly coat a new valve stem seal with engine oil.
3. Insert the new valve stem seal into the valve guide using the special tool Valve stem seal installer (MB991994).

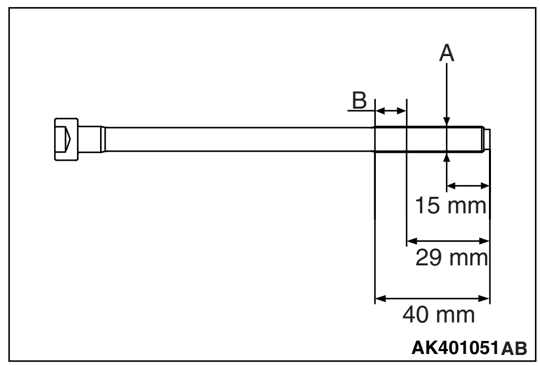
   NOTE: . Use the special tool, on which the number "MB991994A" is stamped.

>>B<< RETAINER LOCK INSTALLATION



While compressing the valve spring using the special tool Valve spring compressor (MD999597), install the retainer lock.

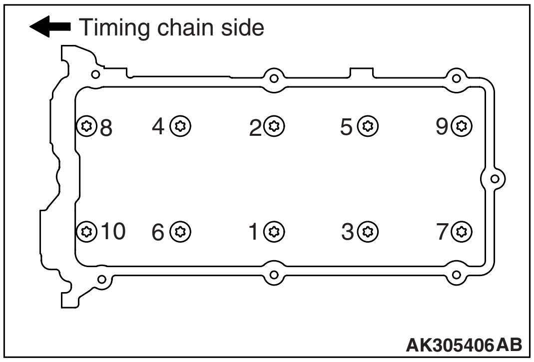
>>C<< CYLINDER HEAD BOLT INSTALLATION



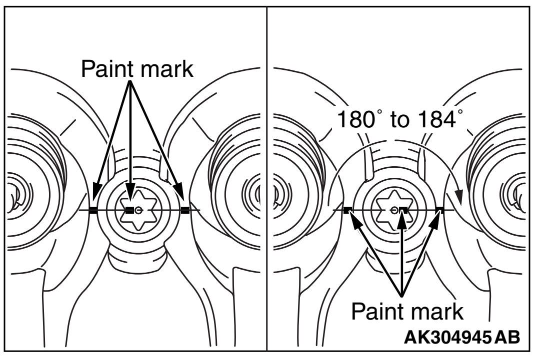
1. Inspect all reused cylinder bolts according to the following procedure.
   (1) Measure the outside diameter shown in the illustration (arrow "A").
   (2) Measure the smaller outside diameter shown in the illustration (arrow "B").
   (3) When the difference between the smaller outside diameters (arrow "A" and "B") exceeds the standard value, replace the cylinder head bolt.

   Standard value: 0 – 0.15 mm

2. Install the cylinder head bolt and washer assembly onto the cylinder head.



3. In accordance with the installation order, tighten them to the specified torque of 24.5 ± 2 N·m in several steps.
4. Make sure all bolts reach the specified torque.



5. Put paint marks on the bolt heads and the cylinder as illustrated.

⚠ CAUTION
- **If the head bolt is tightened less than the specified lower limit of 180 degree angle, the bolt may become loose. Be sure to tighten correctly.**
- **If the head bolt is tightened in excess of the specified upper limit of 184 degree angle, loosen the bolt completely and repeat the entire procedures.**

6. Tighten the bolts in the correct sequence by 180 to 184 degree angle.

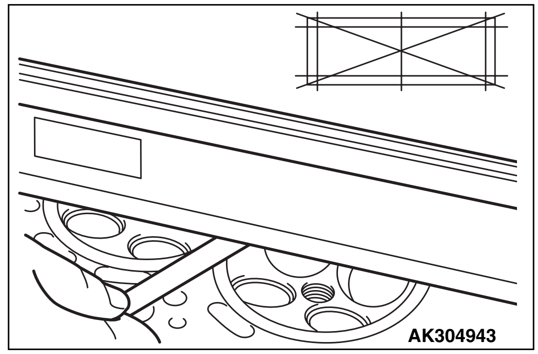
   Ensure that the paint marks on the bolt heads and the cylinder are aligned in a straight line.

INSPECTION

M1113007000862

CYLINDER HEAD

1. Before cleaning, check the cylinder head for leakage of coolant or exhaust gas as well as cracks or other damage.
2. Remove oil, scale, sealant, carbon and other residues completely. Clean the oil passages and blow compressed air through them to verify that they are free of restriction.

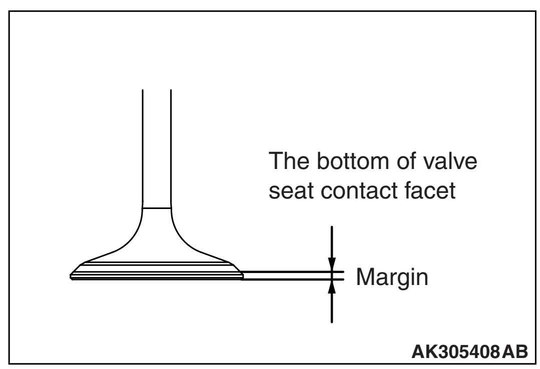


⚠ CAUTION
The grinding limit for the cylinder head and block combined is 0.2 mm.

3. Using a straight edge and a thickness gauge, measure the flatness of the cylinder head bottom surface. If the distortion exceeds the limit, correct it by grinding.

   Bottom face distortion
   Standard value: 0.03 mmor less
   Limit: 0.2 mm
   Grinding limit: 0.2 mm
   Cylinder head height (standard value for new part): 113.0 mm

VALVE

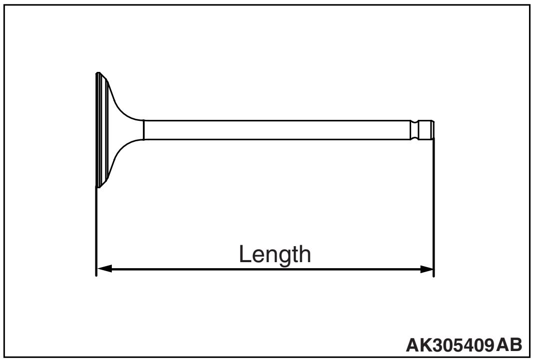


1. If the valve face-to-seat contact is uneven or interrupted, correct the valve seat.
2. Measure the valve head margin. If the measured value exceeds the limit, replace with a new valve.

   Standard value:
   Intake 1.35 mm
   Exhaust 1.85 mm

   Limit:
   Intake 0.85 mm
   Exhaust 1.35 mm

Main Index
Group TOC

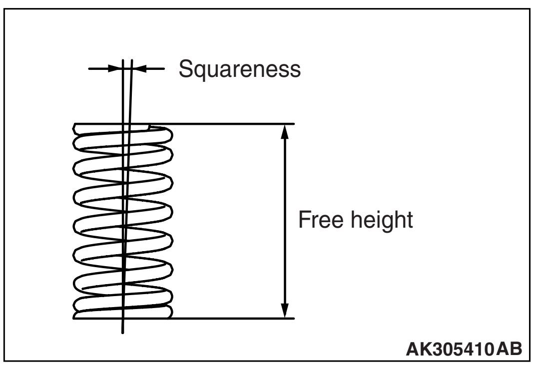


3. Measure the valve overall length. If the measured value exceeds the limit, replace with a new valve.

Standard value:
Intake 89.61 mm
Exhaust 90.94 mm

Limit:
Intake 89.11 mm
Exhaust 90.44 mm

VALVE SPRING



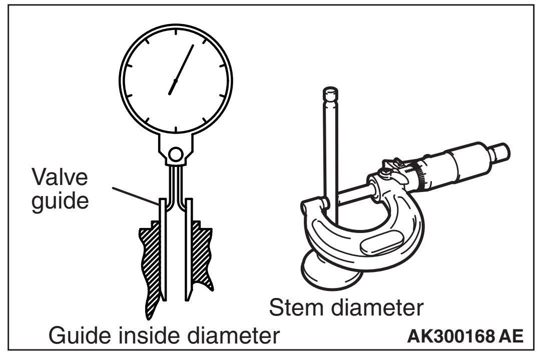
1. Measure the valve spring free height. If the measured value exceeds the limit, replace with a new spring.

Standard value: 43.1 mm
Limit: 42.1 mm

2. Measure the valve spring out-of-squareness. If the measured value exceeds the limit, replace with a new spring.

Standard value: 2° or less
Limit: 4°

VALVE GUIDE

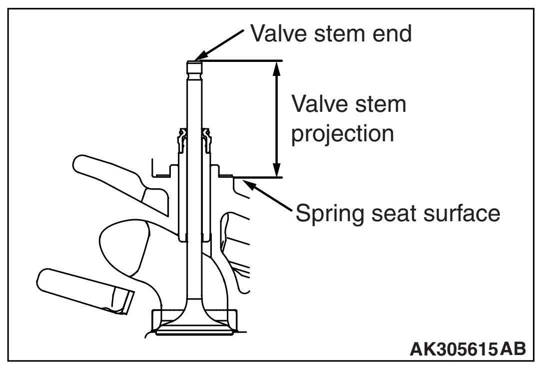


Measure the clearance between the valve guide and the valve stem. If the measured value exceeds the limit, replace the valve guide or the valve, or both.

Standard value:
Intake 0.020 – 0.047 mm
Exhaust 0.030 – 0.057 mm

Limit:
Intake 0.10 mm
Exhaust 0.15 mm

VALVE SEAT



With the valve mechanism assembled and the valve face pressed against the seat, measure the valve stem end protrusion over the cylinder head face where the spring seat is located. If the measured value exceeds the limit, replace the cylinder head assembly.

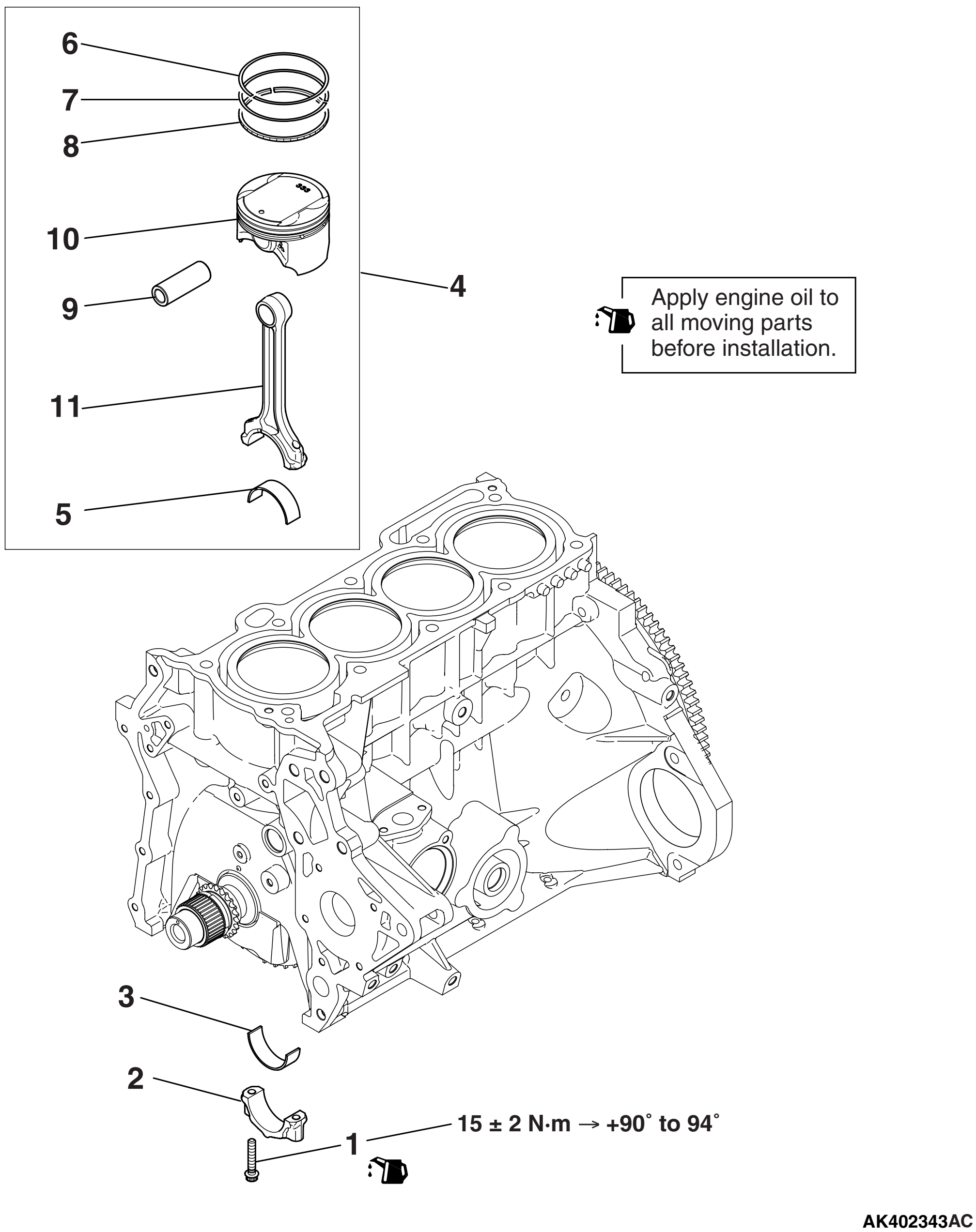
Standard value:
Intake 38.46 mm
Exhaust 38.49 mm

Limit:
Intake 38.96 mm
Exhaust 38.99 mm

PISTON AND CONNECTING ROD

REMOVAL AND INSTALLATION

M1113008401457



Removal steps

- >>**G**<< 1. Connecting rod cap bolt
- <<**A**>> >>**F**<< 2. Connecting rod cap
- >>**E**<< 3. Connecting rod bearing
- >>**D**<< 4. Piston, connecting rod assembly
- >>**E**<< 5. Connecting rod bearing
- >>**C**<< 6. Piston ring, No. 1
- >>**C**<< 7. Piston ring, No. 2

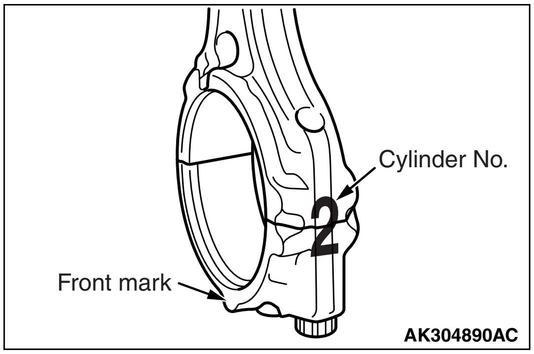
Removal steps (Continued)

- >>**B**<< 8. Oil ring
- <<**B**>> >>**A**<< 9. Piston pin
- 10. Piston
- 11. Connecting rod

Main Index
Group TOC

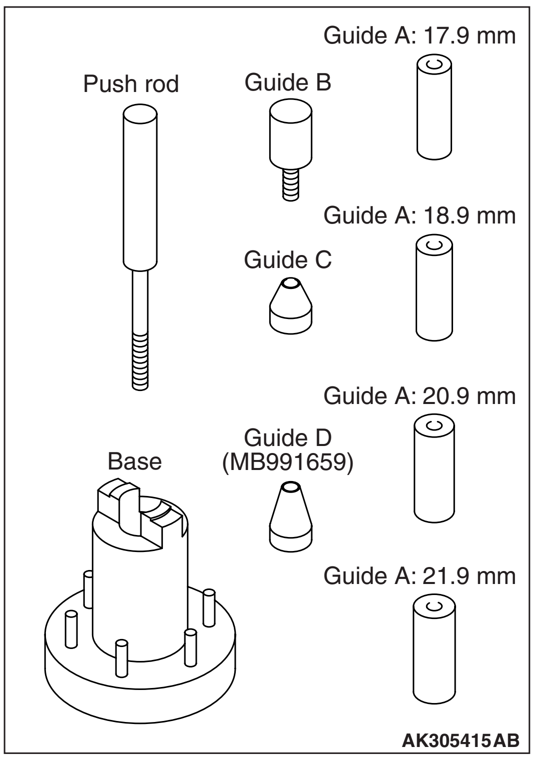
REMOVAL SERVICE POINTS

<<A>> CONNECTING ROD CAP REMOVAL

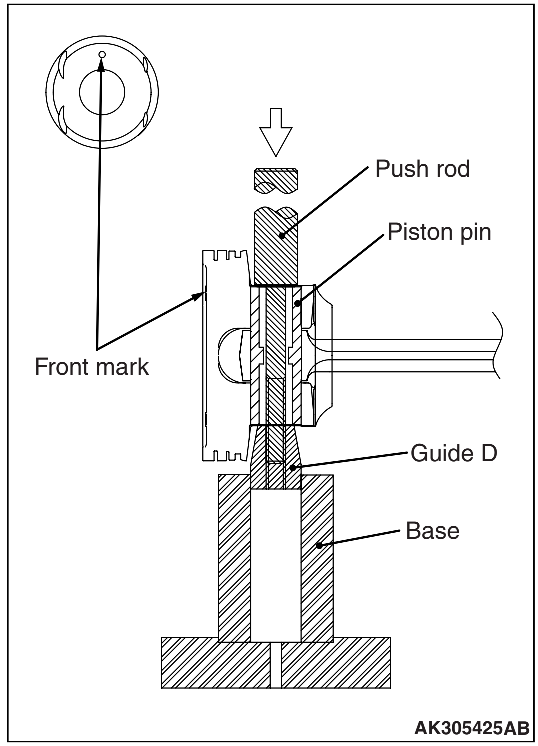


To facilitate reassembly, mark the side face of the connecting rod big end with the corresponding cylinder number.

<<B>> PISTON PIN REMOVAL



The special tool Piston pin setting tool (MD998780) consists of the parts illustrated. The special tool Guide D (MB991659) is also used for removal.



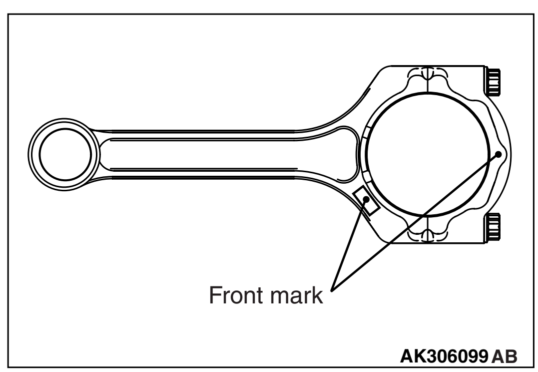
1. Insert the Push rod (special tool) into the piston, from the piston side with the front mark on the piston top face. Install the Guide D on the other side.
2. Install the piston and connecting rod assembly with the tools onto the Piston pin setting base (special tool), ensuring that the piston front mark faces upwards.
3. Using a press, remove the piston pin.

   NOTE: With the piston pin removed, keep the pin, piston and connecting rod of the same cylinder together.

INSTALLATION SERVICE POINTS

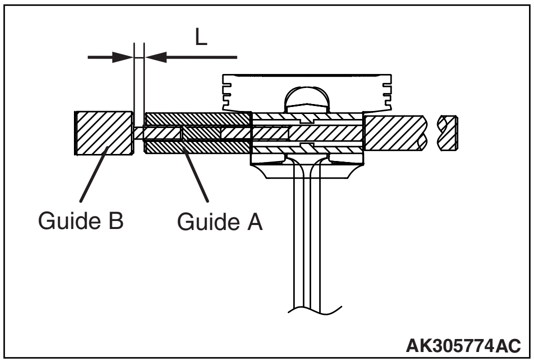
>>A<< PISTON PIN INSTALLATION

1. Insert the special tool Push rod into the piston pin, and install Guide A.

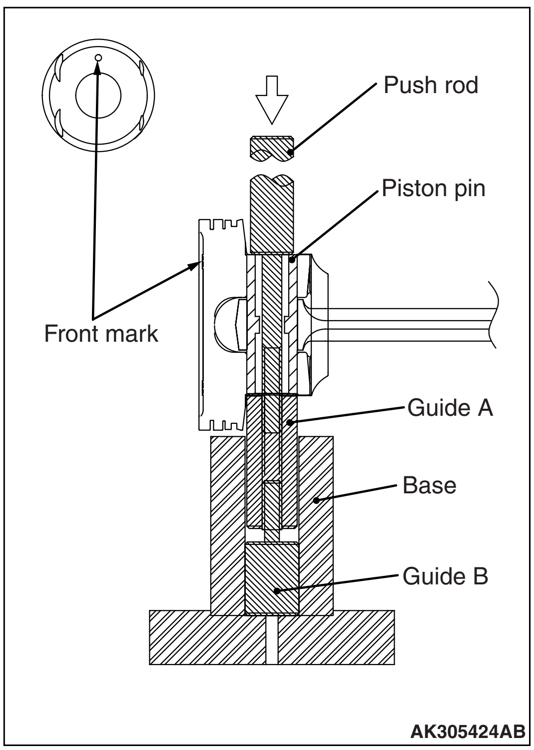


Main Index
Group TOC

2. Assemble the piston and the connecting rod together, ensuring that their front marks are aligned with each other.
3. Apply engine oil onto the periphery of the piston pin.
4. Insert the piston pin assembled in step 1 above into the piston pin boss. Guide A end of the piston pin should be inserted first into the front mark end of the boss.



5. Insert Guide B into Guide A with having 2.25 mm of the clearance "L" between Guide A and B.



6. Install the piston and connecting rod assembly with the tools onto the Piston setting base (special tool), ensuring that the piston front mark faces upwards.
7. Using a press, press fit the piston pin. If the force required to press fit the piston pin is less than the standard value, replace the piston pin (piston assembly) or the connecting rod, or both.

Standard value: 5,000 − 11,000 N

>>B<< OIL RING INSTALLATION

1. Install the oil ring spacer first into the piston ring groove,

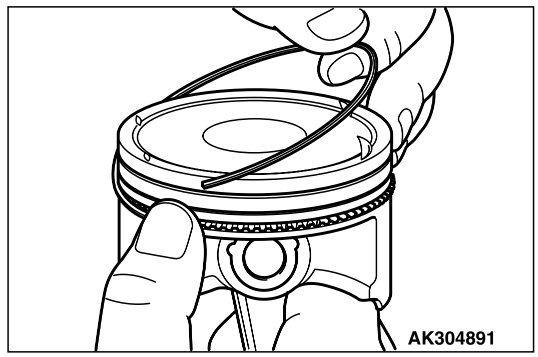
   followed by the upper side rail and then the lower side rail.

   NOTE: New spacers and side rails are an identified by color marks as follows:

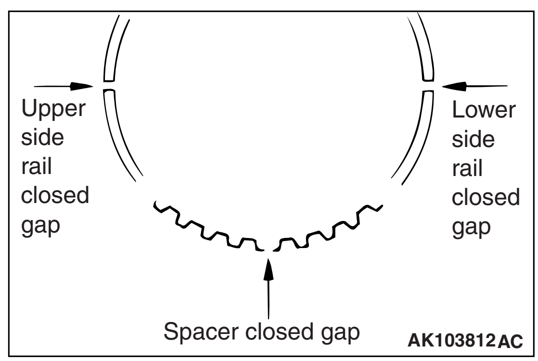
Size	Color mark
Standard	Non mark
0.25 mm oversize	Two blue

⚠ CAUTION

Do not use a ring expander on side rails as they may break when the gap is opened.



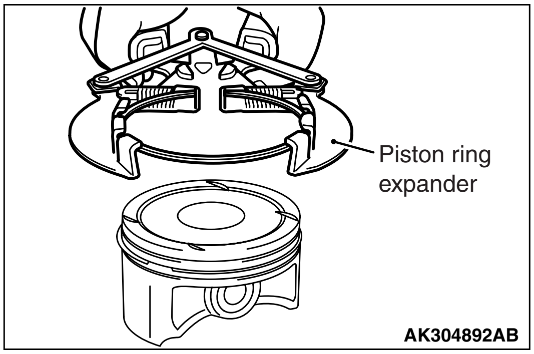
2. Side rails can be installed easily by first inserting one end of the rail into the piston groove, then pressing the rail into place with finger.
3. With the side rails installed onto the piston, check that they can be rotated smoothly in both directions.



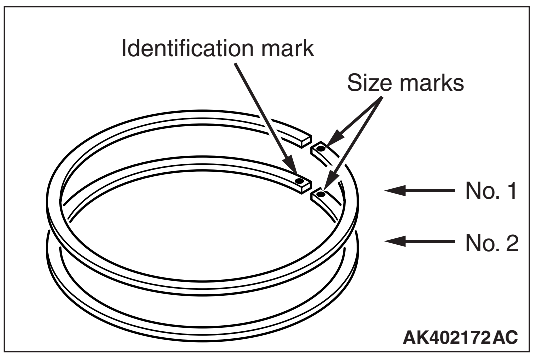
4. The gaps of the side rails and spacer should be located as illustrated.

Main Index
Group TOC

>>C<< PISTON RING NO. 2 / PISTON RING NO. 1 INSTALLATION



Use a piston ring expander to install the No. 1 and No. 2 piston rings. The ring identification mark should face upwards.



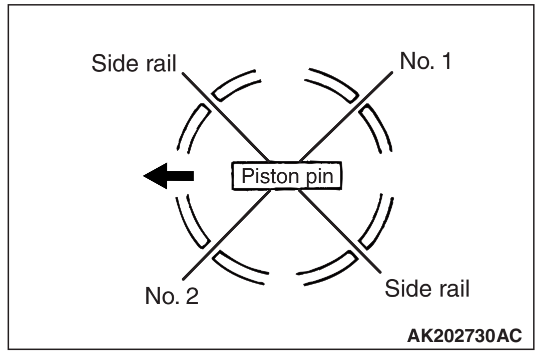
Identification mark
No. 1 ring: None
No. 2 ring: 2R

NOTE: Each of the available piston rings has a size mark as follows:

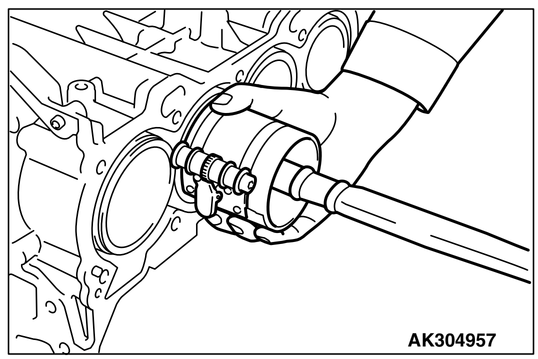
Size		Size mark
Standard	No. 1 ring	No mark (Yellow paint on periphery)
	No. 2 ring	No mark (Yellow paint on periphery)
0.25 mm oversize		25

>>D<< PISTON, CONNECTING ROD ASSEMBLY INSTALLATION

1. Apply engine oil sufficiently onto the piston periphery, the piston rings and the oil ring.



2. Align the gaps of the piston rings and the oil ring (side rails, spacer) as illustrated.
3. Insert the piston and connecting rod assembly from above the cylinder block and through the cylinder bore, ensuring that the front mark on the piston top faces the camshaft sprocket.

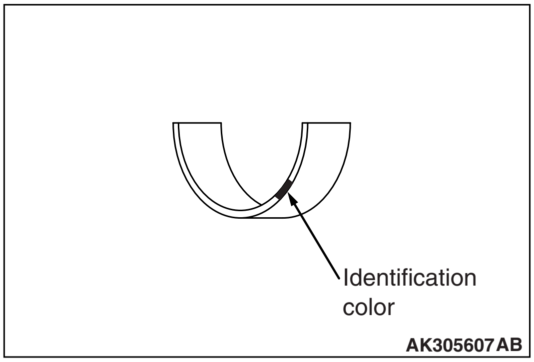


⚠ CAUTION
Do not try to strike hard on the assembly to fit it in place as this will break the piston rings.

4. While firmly holding the piston rings with a ring band, insert the piston and connecting rod assembly into place.

Main Index
Group TOC

>>E<< CONNECTING ROD BEARING INSTALLATION

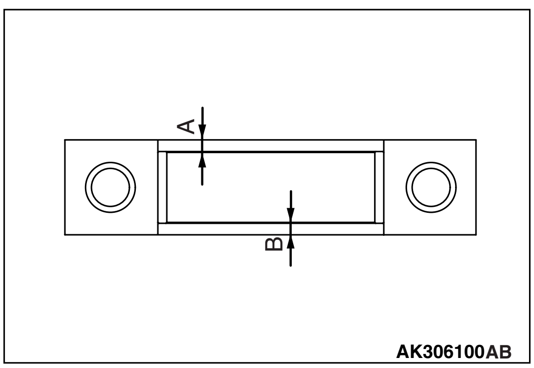


1. Connecting rod bearings are color coded with paint at the illustrated locations. Bearings should be selected based on the following table.

Connecting rod bearing	
Upper bearing	**Lower bearing**
Blue	Red
Red	Blue
Yellow or black	Yellow or black

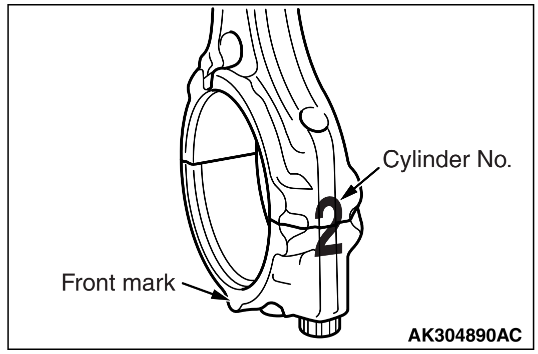
Example: If a blue upper bearing is selected, the lower bearing must be red.

2. Install the bearings selected onto the connecting rod big end and the bearing cap.

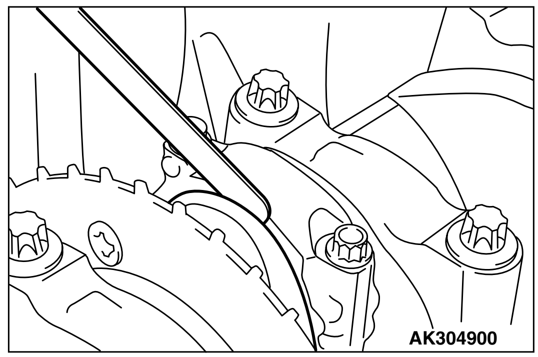


3. Measure the illustrated location. The error should be within 0.5 mm.

>>F<< CONNECTING ROD CAP INSTALLATION



1. Install the correct bearing cap onto the corresponding connecting rod, based on the marking placed during disassembly.



2. Ensure that the thrust clearance of the connecting rod big end is to specification.

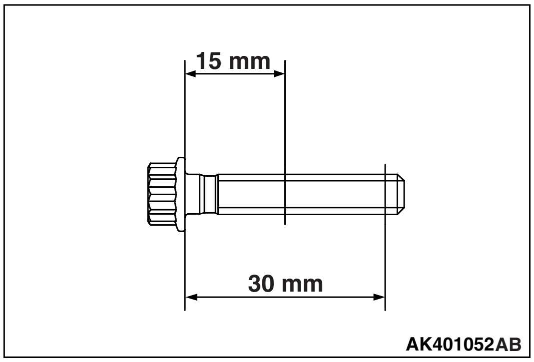
Standard value: 0.10 – 0.35 mm

Limit: 0.4 mm

Main Index
Group TOC

>>G<< CONNECTING ROD CAP BOLT INSTALLATION

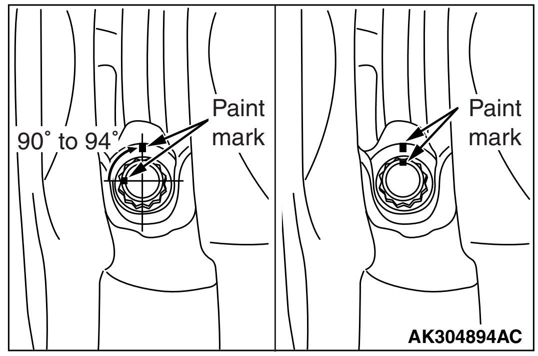
1. Inspect all reused connecting rod bolts according to the following procedure.



   (1) Measure the outside diameter at 15 mm and 30 mm from the head of the connecting rod bolts shown in Figure respectively.
   (2) When the difference between the outside diameters (measured at 15 mm and 30 mm) exceeds the standard value, replace the connecting rod bolts.

   Standard value: 0 – 0.1 mm

2. Apply engine oil to the threaded portion and seating face of the bolt.
3. To correctly install the cap, loosely install the bolts with fingers.
4. Alternately, tighten the bolts in several steps to the specified torque of 15 ± 2 N·m.



5. Put a paint mark on the bolt head as illustrated.
6. Put another paint mark on the bolt head at 90 to 94 degree angle in the tightening direction from the first paint mark.

⚠ CAUTION

- **If the bolt is tightened less than the specified lower limit of 90 degree angle, the bolt may become loose. Be sure to tighten correctly.**
- **If the bolt is tightened in excess of the specified upper limit of 94 degree angle, loosen the bolt completely and repeat the entire procedures.**

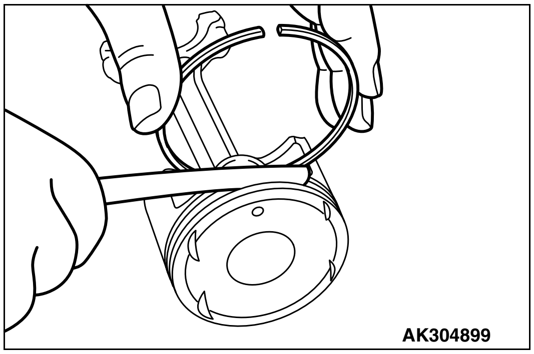
7. Tighten the bolt 90 to 94 degree angle. The paint mark on the connecting rod should be aligned with the paint mark on the bolt.

Main Index
Group TOC

INSPECTION

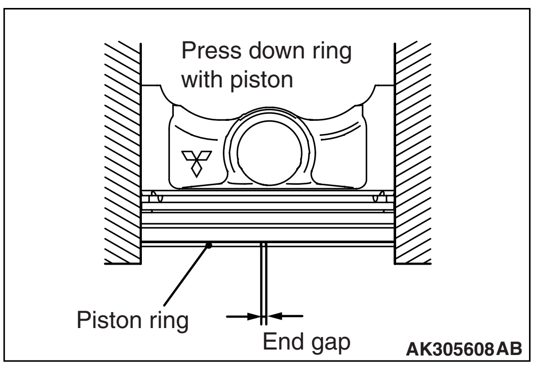
M1113008500837

PISTON RING



1. Measure the clearance between the piston ring and the ring groove. If the measured value exceeds the limit, replace the piston ring, or both the piston and the piston ring.

Standard value:
No. 1 ring: 0.03 – 0.07 mm
No. 2 ring: 0.02 – 0.06 mm
Limit: 0.1 mm



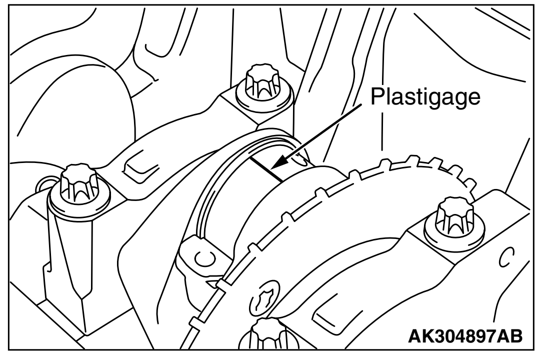
2. Insert the piston ring into the cylinder bore. Insert the piston with the top face end first into the cylinder bore, pushing the piston ring and positioning it squarely with the cylinder bore. Then, measure the piston ring end gap using a feeler gauge. If the measured value exceeds the limit, replace the piston ring.

Standard value:
No. 1 ring: 0.15 – 0.30 mm
No. 2 ring: 0.20 – 0.40 mm
Oil ring: 0.10 – 0.40 mm

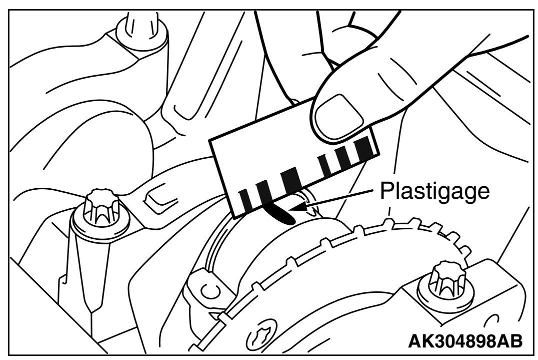
Limit:
No. 1 ring: 0.8 mm
No. 2 ring: 0.8 mm
Oil ring: 1.0 mm

CRANKSHAFT PIN OIL CLEARANCE (PLASTIGAGE METHOD)

1. Wipe off oil from the crankshaft pin and the connecting rod bearings.
2. Place a plastigage, with a length equal to the bearing width, onto the crank pin in the axial direction.



3. Carefully install the connecting rod cap over the plastigage, and tighten the bolts to 15 ± 2 N·m → + 90 to 94 degree angle.
4. Remove the bolts. Slowly remove the connecting rod cap.



5. Using the measure printed on the plastigage package, measure the width (widest portion) of the crushed plastigage.

Standard value: 0.014 – 0.059 mm
Limit: 0.1 mm

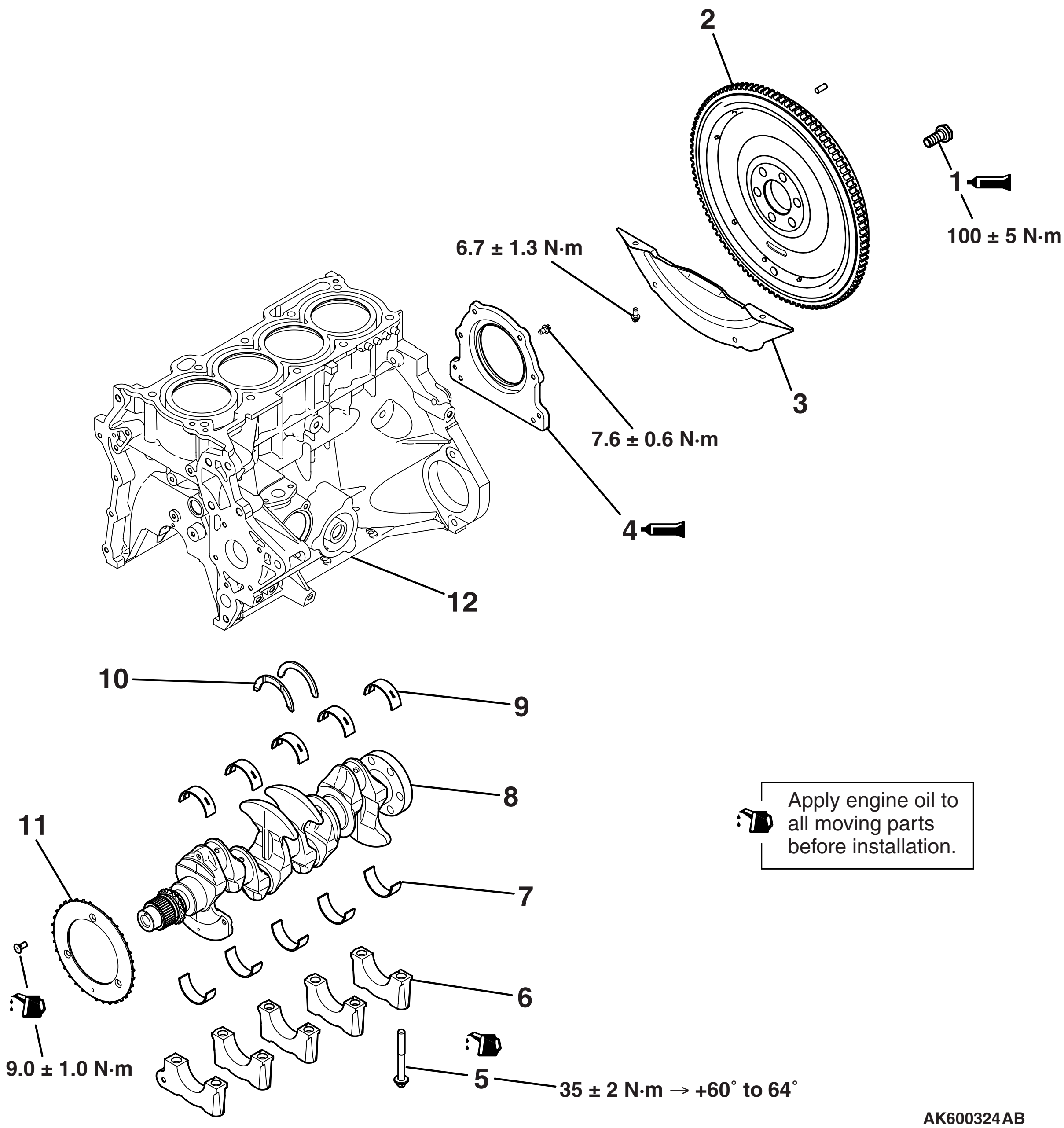
Main Index
Group TOC

CRANKSHAFT AND CYLINDER BLOCK

REMOVAL AND INSTALLATION

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<M/T>



Removal steps

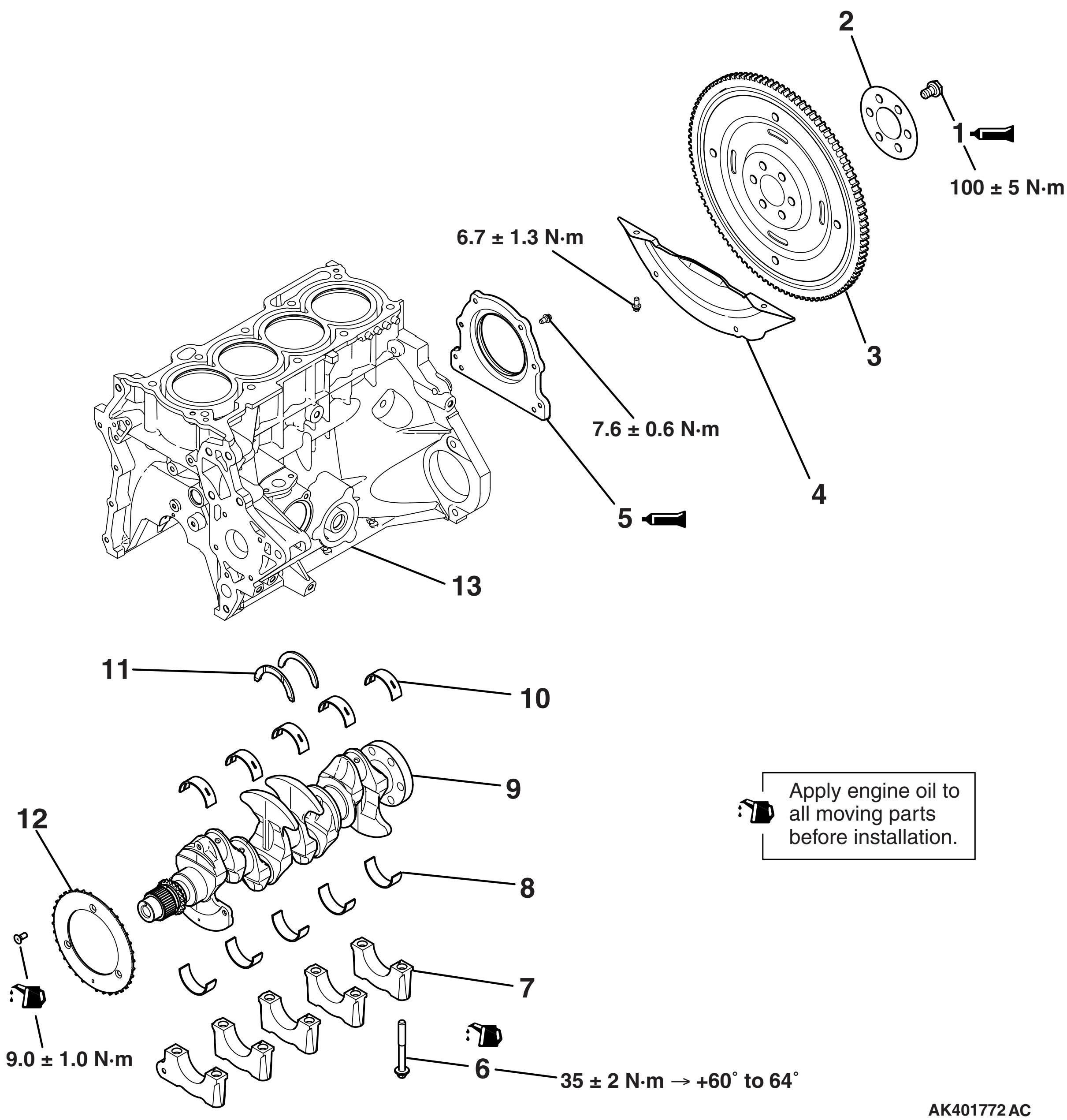
- <<**A**>> >>**G**<< 1. Fly wheel bolt
- 2. Fly wheel
- 3. Bell housing cover
- 4. Oil seal case
- >>**F**<< 5. Crank shaft bearing cap bolt
- >>**E**<< 6. Crankshaft bearing cap

Removal steps (Continued)

- >>**E**<< 7. Crankshaft bearing, lower
- >>**D**<< 8. Crankshaft
- 9. Crankshaft bearing, upper
- >>**C**<< 10. Thrust bearing
- >>**B**<< 11. Crankshaft sensing ring
- >>**A**<< 12. Cylinder block

Main Index
Group TOC

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Removal steps

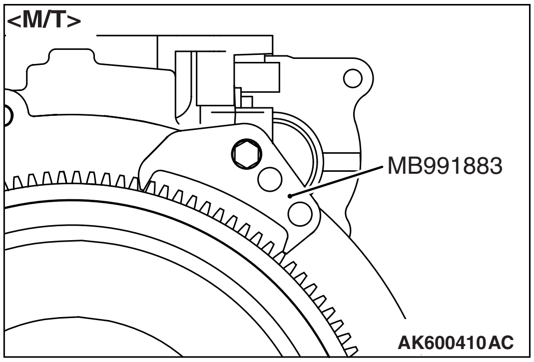
<<**A**>> >>**G**<< 1. Drive plate bolt
2. Adapter plate
3. Drive plate
4. Bell housing cover
>>**F**<< 5. Oil seal case
>>**E**<< 6. Crankshaft bearing cap bolt
>>**E**<< 7. Crankshaft bearing cap
>>**D**<< 8. Crankshaft bearing, lower

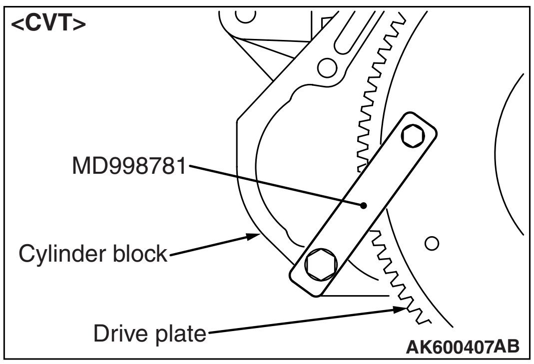
Removal steps (Continued)

9. Crankshaft
>>**C**<< 10. Crankshaft bearing, upper
>>**B**<< 11. Thrust bearing
>>**A**<< 12. Crankshaft sensing ring
13. Cylinder block

REMOVAL SERVICE POINTS

<<A>> DRIVE PLATE BOLT/FLYWHEEL BOLT REMOVAL

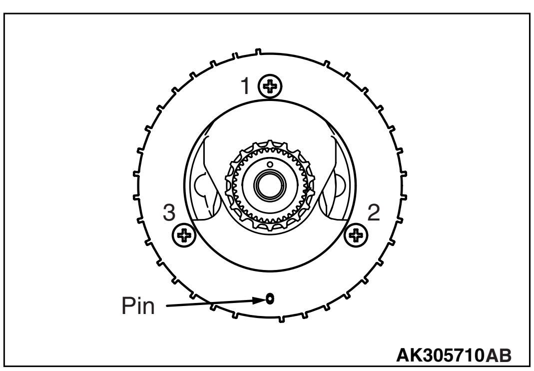




1. Lock the drive plate or the flywheel using the special tool Flywheel stopper.
2. Remove the drive plate bolt.
 - Flywheel Stopper (MD998781)
 - Flywheel Stopper (MB991883)

INSTALLATION SERVICE POINTS

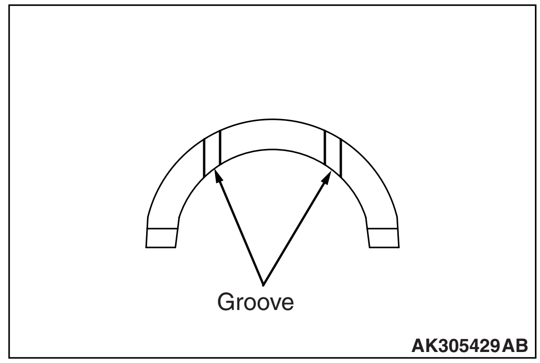
>>A<< CRANKSHAFT SENSING RING INSTALLATION



1. Apply engine oil to the crankshaft sensing ring screw.
2. Tighten the crankshaft sensing ring screws to 9.0 ± 1.0 N·m in the steps given in the illustrated.

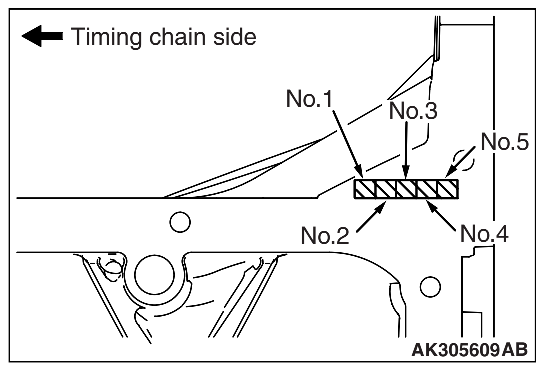
>>B<< THRUST BEARING INSTALLATION

1. Install the thrust bearing onto the cylinder block side of the No. 4 bearing. Apply engine oil to the thrust bearing to facilitate installation.

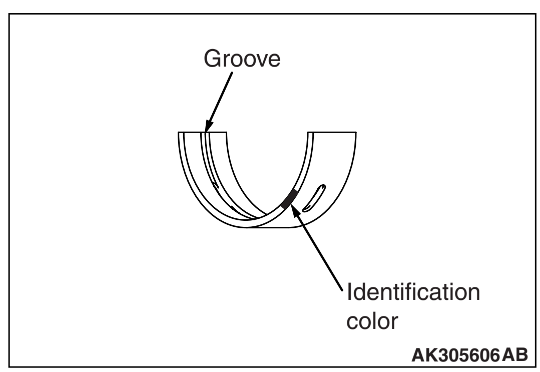


2. The thrust bearing should be installed such that its groove faces the crankshaft weight.

>>C<< CRANKSHAFT BEARING UPPER INSTALLATION



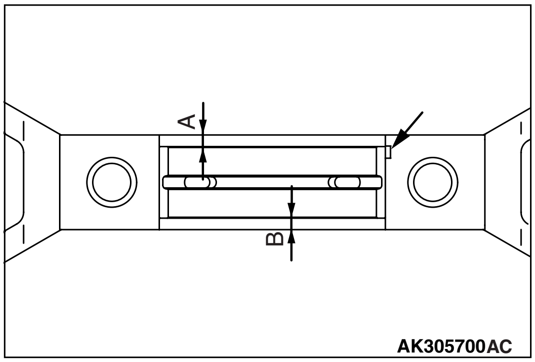
1. The crankshaft bearing upper should be selected based on the identification mark on the bottom face of the cylinder block (illustrated) and the table shown below.



2. Every crankshaft bearing upper is identified by the paint mark at the illustrated location.

Main Index
Group TOC

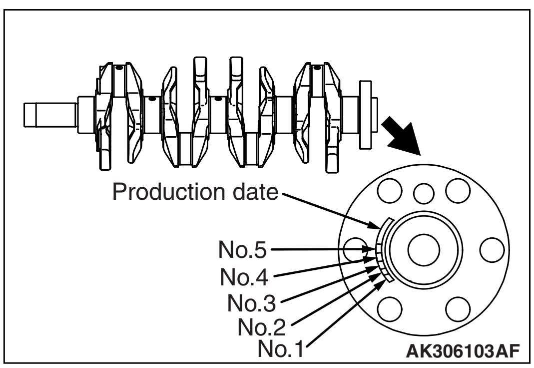
Cylinder block		Crankshaft bearing paint color
Identification mark	Journal diameter mm	
1	50.000 – 50.005	Blue
2	50.005 – 50.010	Black
3	50.010 – 50.015	Red



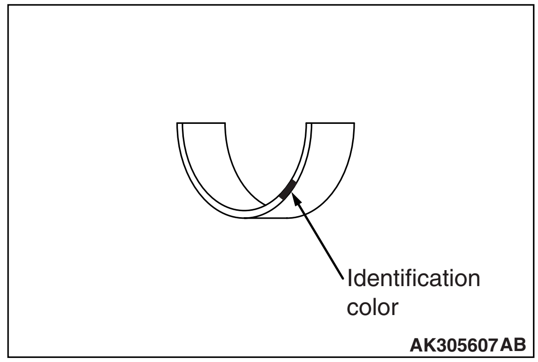
3. Select and install the crankshaft bearing upper.
4. Measure the illustrated location. The error should be within 0.5 mm.

   In case of the service part, install it aligning the bearing projection with the places shown in Figure.

>>D<< CRANKSHAFT BEARING LOWER INSTALLATION

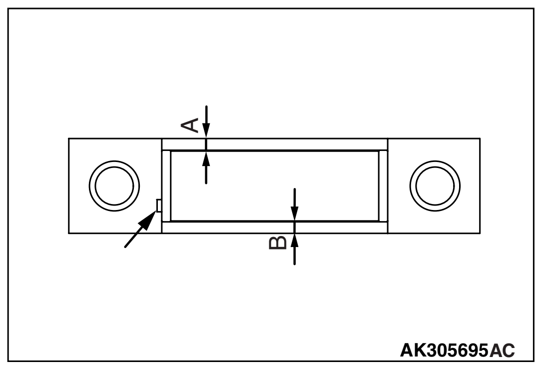


1. The crankshaft bearing lower should be selected based on the identification mark on the crankshaft rear flange (illustrated) and the table shown below.



2. Every crankshaft bearing lower is identified by the paint mark at the illustrated location.

Crankshaft		Crankshaft bearing paint color
Identification mark	Journal diameter mm	
P	46.024 – 46.029	Blue
Y	46.019 – 46.024	Yellow or Black
N	46.014 – 46.019	Red
W	46.009 – 46.014	White
B	46.004 – 46.009	Purple

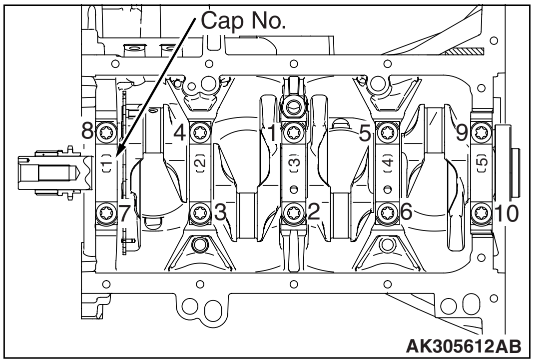


3. Select and install the crankshaft bearing lower.
4. Measure the illustrated location. The error should be within 0.5 mm.

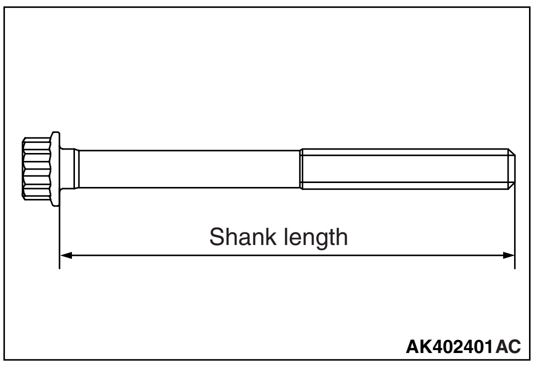
   In case of the service part, install it aligning the bearing projection with the places shown in Figure.

Main Index
Group TOC

>>E<< BEARING CAP / BEARING CAP BOLT INSTALLATION



1. Install the bearing cap, based on the identification mark at the illustrated location.



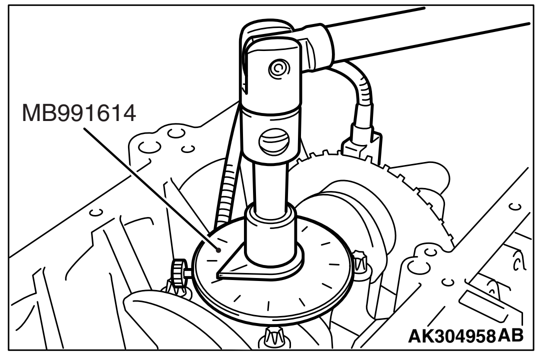
2. Before the bearing cap bolt is installed, make sure the nominal length of the bolt is below the limit. If above the limit, replace the bolt with the new one.

   Standard value: 75.3 mm

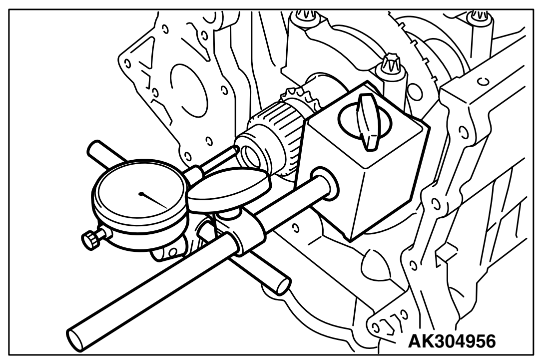
3. Apply engine oil to the threaded portion and seating face of the bolt.
4. Tighten the bearing cap bolts in the illustrated sequence to 35 ± 2 N·m.

⚠ CAUTION

- **If the bolt is tightened less than the specified lower limit of 60 degree angle, the bolt may become loose. Be sure to tighten correctly.**
- **If the bolt is tightened in excess of the specified upper limit of 64 degree angle, loosen the nut completely and repeat the entire procedures.**



5. Using the special tool Angle gauge (MB991614), tighten the bearing cap bolts in the illustrated sequence by a further 60 to 64 degree angle.



6. With the bearing caps installed, check the crankshaft end play. If the measured value exceeds the limit, replace the crankshaft bearings.

   Standard value: 0.09 – 0.27 mm
   Limit: 0.30 mm

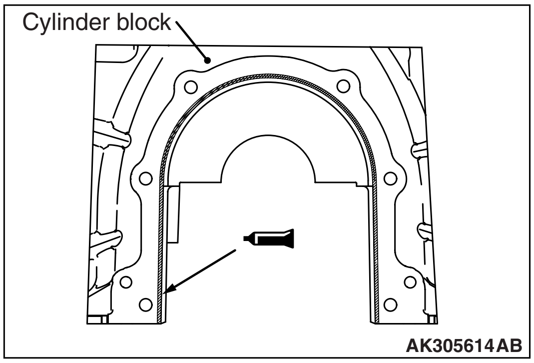
Main Index
Group TOC

>>F<< OIL SEAL CASE INSTALLATION

1. Remove any liquid gasket remaining on the oil seal case and the cylinder block.

⚠ **CAUTION**

The oil seal case should be installed within 3 minutes of applying liquid gasket.



2. Apply a 2.0 ± 0.5 mm bead of liquid gasket as illustrated.

Specified sealant:
LOCTITE 5971 or equivalent

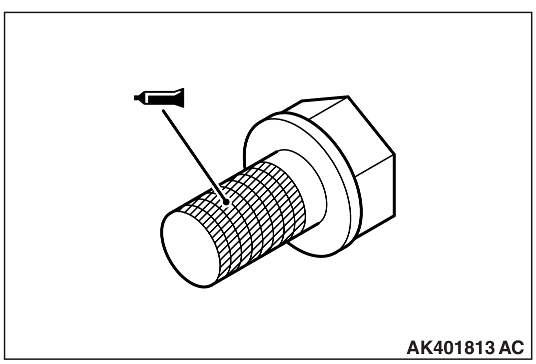
3. Install the oil seal case, tightening the fittings to 7.6 ± 0.6 N·m.

>>G<< DRIVE PLATE BOLT INSTALLATION

1. Remove any sealant remaining on the drive plate bolt or the threaded hole in the crankshaft.

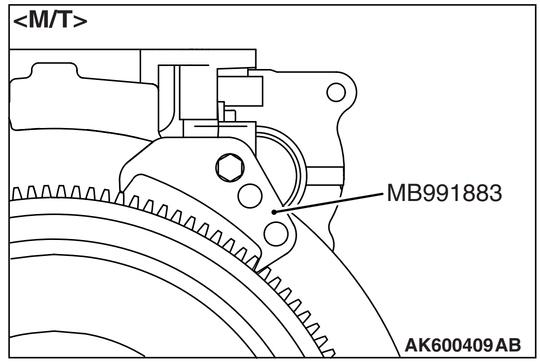
⚠ **CAUTION**

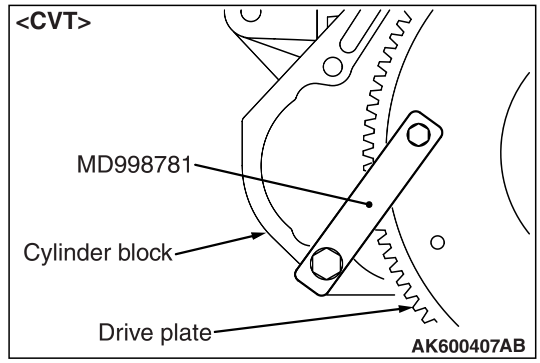
Apply sealant correctly so that it will not be squeezed out onto the end of the threaded portion upon assembly.



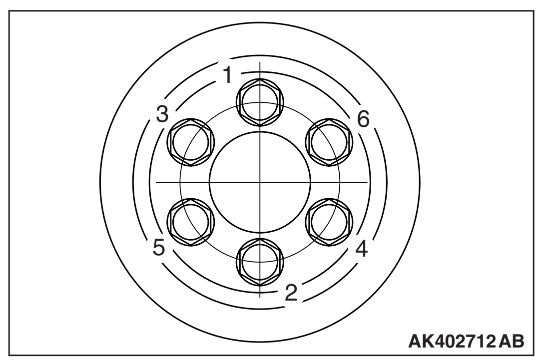
2. Apply sealant to the threaded portion of the drive plate bolt as illustrated.

Specified sealant:
LOCTITE 2701 or equivalent





3. Fix the drive plate or the flywheel in place using the special tool Flywheel stopper.
   - Flywheel Stopper (MD998781)
   - Flywheel Stopper (MB991883)



4. In accordance with the numerical order shown in the illustration, tighten the drive plate bolt to the specified torque of 100 ± 5 N·m in several steps.

Main Index
Group TOC

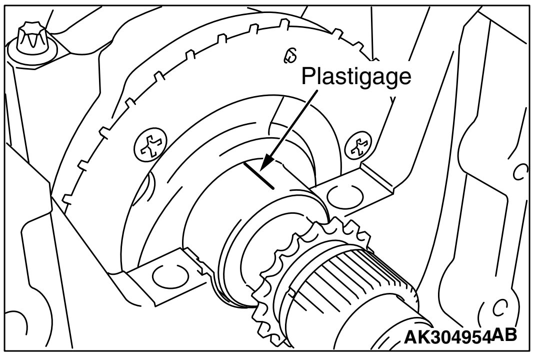
INSPECTION

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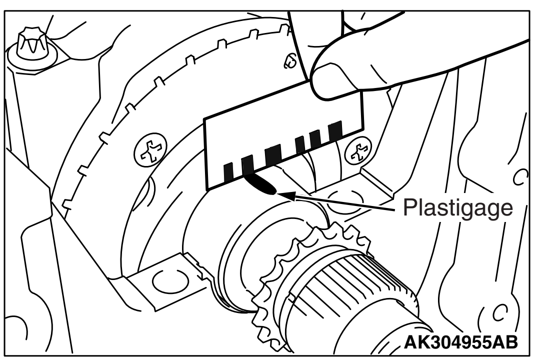
CRANKSHAFT OIL CLEARANCE (USING PLASTIGAGE)

Oil clearance can be measured easily by using "plastigage."
Use the "plastigage" in the following manner.

1. Wipe off oil from the surfaces of the crankshaft journals as well as the inner surfaces of the bearings.
2. Assemble the crankshaft.



3. Place a plastigage, with a length equal to the width of the bearing, onto the journals in the axial direction.
4. Carefully place the main bearing caps, and tighten the bolts to the specified torque.
5. Remove the bolts. Carefully remove the main bearing caps.



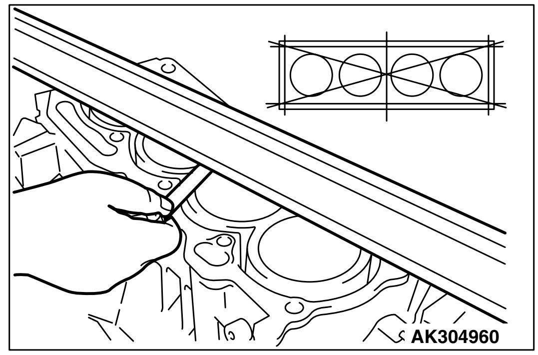
6. Using the measure printed on the plastigage package, measure the width (widest portion) of the crushed plastigage.

   Standard value: 0.014 – 0.034 mm

   Limit: 0.1 mm

CYLINDER BLOCK

1. Check visually for scoring, rust, or corrosion. Perform liquid penetrant test etc. to check for cracks. If faulty, replace.

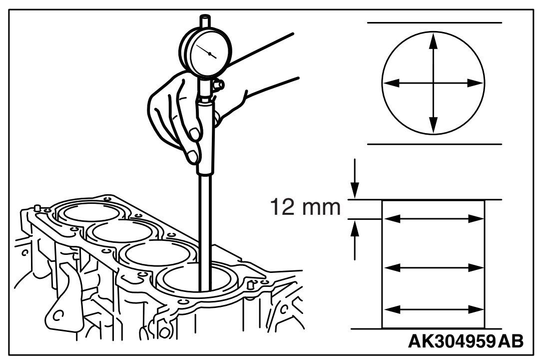


2. Using a straight edge or a thickness gauge, measure the flatness of the cylinder block top surface. Ensure that no gasket or other foreign matter is attached to the top face.

   Standard value: 0.05 mm

   Limit: 0.1 mm

3. Check the cylinder bore for scoring or seizure. If faulty, correct (boring) or replace.

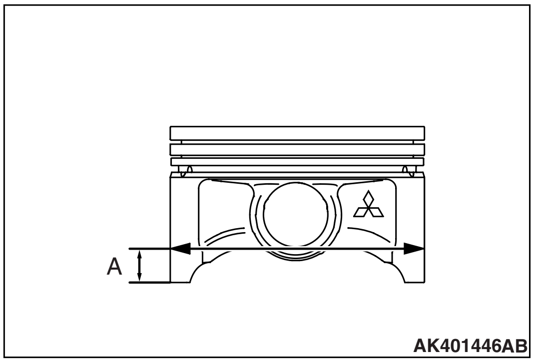


4. Using a cylinder gauge, measure the cylinder bore and centricity. If excessively worn, bore the cylinder and replace the piston and piston rings.

   Standard value:
   Inner diameter 75.0 mm
   Cylindrically 0.007 mm

Main Index
Group TOC

BORING CYLINDERS



1. Oversize pistons should be based on the largest bore cylinder.

Size	Size mark
0.25 mm oversize	25

NOTE: The size mark is stamped on the piston top.

2. In case of 0.25 mm oversized piston, a hole shall be bored through the cylinder block so that the clearance can have the standard value. The standard measuring point for the outside piston diameter is at "A" shown in the illustration.

Standard measuring point A: 12.0 mm

3. Based on the measured piston outside diameter (O.D.), calculate the boring finish dimension.

Boring finish dimension = Piston O.D. + 0.015 – 0.035 mm (Clearance between piston O.D. and cylinder) - 0.02 mm (honing margin)

4. Bore each cylinders to the calculated boring finish dimension.

⚠ CAUTION

To prevent distortion caused by heat increased during boring, bore the cylinders in the following order: No.2, No.4, No.1, No.3.

5. Hone the cylinders to the final finish dimension (piston O.D. + piston-to-cylinder clearance).
6. Check the clearance between the pistons and cylinders.

Standard value: 0.015 – 0.035 mm

NOTE: When boring cylinders, finish all of four cylinders to the same oversize. Do not bore only one cylinder to an oversize.